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THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY. APPENDIX B. IMPA--ETC(U)
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THE Codorus Creek WASTEWATER MANAGEMENT STUDY

APPENDIX B – IMPACT STUDIES

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THE Codorus Creek WASTEWATER MANAGEMENT STUDY.

APPENDIX B. 4 IMPACT STUDIES.

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PREFACE

This Appendix describes the assessment and evaluation of impacts of several alternative wastewater management plans for the Codorus Creek Basin. Chapters II through VI are the actual studies of specific impact areas which were performed for the Corps of Engineers by Abt Associates, Incorporated, of Cambridge, Massachussetts, and the U.S. Public Health Service. Chapter I ties together the more pertinent results of the impact studies and the professional judgment of the in-house study staff.

CHAPTER I

SUMMARY OF IMPACT STUDIES

A. OBJECTIVE

Generally, the objective of the Codorus Creek Wastewater Management Study was to develop an implementable plan for managing the municipal and industrial wastewater of the Codorus Creek Basin in such a way as to produce a significant improvement in water quality. This general statement of objective, however, does not provide the guidance necessary to answer the very pertinent question: "How much should the water quality be improved?" The Codorus Creek Wastewater Management Study could have responded to this question by adopting the present standards developed by the Commonwealth of Pennsylvania for Codorus Creek as the study's performance criteria for every alternative considered. The recommended plan could have been selected, therefore, based on economic efficiency, that is, the satisfaction of the performance criteria at the lowest possible cost.

The Corps of Engineers, however, is bound by a Federal commitment in water resources planning which requires the equal consideration of four broad objectives--environmental quality, well-being of the people, and National and regional development. The Corps of Engineers,

in the Codorus Creek Wastewater Management Study, is planning for the first time a system of wastewater management. Consistent with its past role in multiple-purpose water resource planning, however, the Corps felt it proper to relate wastewater management to total water management and total resource management and use. Thus, the study objective of improved water quality had to be viewed in a larger context of the overall national concerns related to environmental quality, well-being, and National and regional development. For the Codorus study, the particular vehicle for contributing to the broad objectives has been through a program to improve water quality, but the relative merits and disadvantages of particular alternative wastewater management plans at various levels of performance had to be understood in the context of the four broad objectives.

In order to evaluate the wastewater management alternatives considered in the Codorus Creek study, it was necessary to select from amongst the four broad objectives those specific components to which wastewater management programs could be expected to contribute. For instance, under national economic development, wastewater management programs can contribute to the efficiency component. Under the well-being objective, the alternatives can contribute to the social and health components. Similarly, in the Codorus Creek Wastewater Management Study, six components were selected and upon each of these, impact

studies were performed. The six impact areas are (1) economic, (2) social, (3) aquatic ecology, (4) terrestrial ecology, (5) visual, and (6) public health risk. All of these studies were performed by professionals who were not members of the staffs of the Corps of Engineers or any of the other study participants. Chapters II through VI are reports for each of the impact studies.

B. METHODOLOGY

The detailed impact studies were performed on the alternatives which survived the October 1971 Policy Committee - Plan Formulation meeting. There were four *basic configurations:* (1) a decentralized water-oriented system, (2) a centralized water-oriented system, (3) a combination water-land system, and (4) a variation of the combination water-land system involving industrial re-use of treated municipal wastewater. Each water-oriented system was analyzed at two treatment levels. The two levels differed only in the amount of nutrients removed. The low level would remove 80 percent of the phosphorous and none of the nitrogen, while the high level would accomplish 98 percent phosphorous removal and a similarly high level of nitrogen removal.

Each impact consultant was responsible for one impact area and attempted to "measure" the change in a particular impact area due to the hypothetical implementation of a specific alternative. The change

was the difference between the condition "with" and "without" the alternative. The "without" or baseline condition was defined as that which would most likely exist without regional wastewater management. It was assumed that the decentralized water-oriented system at the lower performance level adequately approximated a reasonable baseline condition.

With four system configurations and with two of the configurations being evaluated at two performance levels, there was a total of six alternatives to be evaluated. In practice, the evaluations focused on the two basic differentiating aspects of the six alternatives--the (two) treatment levels and the (four) system configurations.

C. IMPACT RESPONSE TO VARYING PERFORMANCE LEVEL

The Codorus Creek Wastewater Management Study addressed several treatment performance levels.[1/] Every level of treatment considered in the study was, at the very least, capable of satisfying water quality standards set by the Commonwealth of Pennsylvania. By the time the impact studies were initiated, the technical study had begun to focus on two performance levels, denoted as Level B and Level D.

1/ All of the performance levels are discussed in detail in Appendix A.

Level B approximated the requirements already defined by the Commonwealth of Pennsylvania. This standard included almost complete removal of biochemical oxygen demand (BOD), post-aeration to provide a concentration of dissolved oxygen (D.O.) in the final effluent at least equal to two parts per million (ppm), and 80 percent removal of phosphorous.

Level D included all the treatment requirements of Level B, but added nitrogen removal and 98 percent phosphorous removal. (Land disposal would achieve slightly better treatment than Level D.)

All of the impact studies focused of these questions: "Is there a benefit to be derived from removing the increment of nutrients between Levels B and D?" and, if the answer was "yes", then "What is the benefit?"

Although they varied in their degree of explicitness as to the nature of the benefit, in general, all of the impact studies supported the notion that there is a benefit to be realized by opting for Level D rather than Level B. For instance, the report on public health risks[2/] states that Level B would "reduce microbial contamination significantly in the various water courses in the Codorus Basin by providing improved sewage treatment," but that, with Level D, "still further reduction in microbial contamination would result" by providing "still further treatment" than Level B.

2/ Presented as Chapter VI in this Appendix.

The social-economic report[3/], in discussing the potential enhancement of leisure opportunities which would result from having available high quality streams, describes, as an example, the possibility of Codorus Creek becoming a "focal point of passive urban recreation," but states that "such a stream use seems more likely if municipal and industrial effluents are treated to the limits of tertiary technology."

A similar argument is presented in the visual impact report.[4/] It states that "if the stream is indeed to become a focus for urban development, it would be foolish economy to invest in any but the most advanced water treatment equipment. Though the higher cost might seem a deterrent, it is a legitimate opportunity cost for realizing potentials otherwise impossible."

D. IMPACT RESPONSE TO SYSTEM CONFIGURATION

The findings of the impact studies regarding differences between the four system configurations were less unanimous but more specific. Figure 1 presents a summary of the impact evaluation of the system configurations in the form of a matrix. The following discussions explain the entries in the matrix.

Economic Stimulation (short term). In general, any multimillion dollar construction program would have considerable impacts on the

3/ Presented as Chapter II in this Appendix.

4/ Presented as Chapter III in this Appendix.

FIGURE 1

IMPACT EVALUATION MATRIX

IMPACT AREAS \ ALTERNATIVE SYSTEMS	Decentralized Water-Oriented	Centralized Water-Oriented	Combination Water-Land	Industrial Re-Use Water-Land
I. Social-Economic				
A. Economic Stimulation (Short term)	+	+	+	+
B. Economic Stimulation (Long term)	+	+	+	+
C. Employment	+	+	+	+
D. Housing and Public Service	N	N	-	-
E. Leisure Opportunities	+	+	+	+
F. Agriculture	N	N	+	+
G. Land Use	N	N	+	+
H. Land Values	N	N	-	-
II. Visual				
A. Direct, Treatment Facilities	N	-	-	-
B. Indirect, Resultant Water Quality	+	+	+	+
III. Aquatic Ecology	+	+	+	+
IV. Terrestrial Ecology	N	+	+	+
V. Public Health Risk	+	+	I	I

+ Positive impact
- Negative impact
N No impact
I Impact not determined

economy of the Codorus Creek Basin. Large amounts of this money would be pumped into the study area via the purchase of land and local materials and labor and the increased demand for local goods and services generated by inmigrating construction and operating personnel.

Economic Stimulation (long term). A region with a coherent system of treatment facilities should attract people--and industry. An increasing consciousness of environmental quality implies that people will prefer to live in places where at least some of the environmental problems have been solved; this in turn implies that firms locating in the basin will have a relative advantage in attracting manpower.

A firm which produces a significant amount of wastewater should be attracted to an area with regional wastewater treatment facilities if the system is sufficiently flexible to accomodate it. With regard to flexibility, the following comments apply:

(1) The decentralized water disposal system would slightly favor already established areas for industrial location.

(2) The centralized water disposal system would favor industrial location near regional treatment plants.

(3) The combination land and water disposal system would tend to discourage industrial development beyond levels provided for in the initial design for the southern parts of the basin.

Employment. The implementation of any of the proposed alternatives would increase the level of employment in the study area by (1) creating a demand for labor in the construction process, much of which would be local, and (2) creating a demand for operating personnel, most of which would have to be provided from outside the study area. The increased demand by local workers and new demand by inmigrating workers for local goods and services would have a multiplier effect on local employment and economic activity.

Housing and Public Services. Schools and other public services should not be affected by any of the alternatives. An already strained housing supply, however, might make it difficult to find new homes for people displaced by the acquisition of land for any system utilizing land disposal of wastewater.

Leisure Opportunities. All four of the system configurations could greatly enhance the potential recreational experience offered by Codorus Creek through and below the City of York and could create a recreational possibility at Indian Rock Dam.

In addition, the reuse option offers the possibility of opening Lake Marburg to full public use and the use of land disposal could act to preserve open space from urban encroachment by incorporating effluent irrigation areas which would constitute natural buffer zones between urban areas.

Agriculture. Disposal of treated wastewater on land would provide irrigation water and valuable fertilizer for crops.

Land Use. Generally, all four systems are designed to complement the York County Planning Commission's Land Use Plan or at least not to conflict with it. The system which uses land disposal in a portion of the basin also provided areas satisfying greenbelt functions. Industrial reuse might allow a fuller recreational use of Lake Marburg.

Land Values. The construction of treatment plants and pipelines should not seriously alter study area land values. Treatment plants fit fairly comfortably into industrial zones. Most sites being considered are already industrial in character.

Land use for lagoons is likely to depress surrounding land values. Careful design and site selection could act to overcome this negative impact.

Land use for irrigation purposes may either decrease or increase the desirability of neighboring land for higher uses. From a residential viewpoint, the expectation (even if unjustified) that odors would result from the irrigated area would tend to make neighboring land less desirable.

Direct Visual, Treatment Facilities. The basic premise is rather pessimistic and is as follows: Any construction endeavor, being almost by definition disruptive, and therefore having a (visually) negative potential, will in fact have a negative visual impact.

Based on that premise, the decentralized system, by approximating the status quo, would have no impact. The other alternatives, by adding interceptors, storage lagoons, and irrigation rigs, would have negative impacts.

Indirect Visual, Resultant Water Quality. All four alternatives, operating at the highest technically feasible performance levels, would greatly enhance the visual attributes of Codorus Creek.

Aquatic Ecology. All system configurations would enhance the creek's environment for aquatic life, decrease eutrophic potential of the Susquehanna River by removing phosphorous and decrease the nitrogen load on Chesapeake Bay.

Terrestrial Ecology. Water disposal treatment methods pose no threat nor do they offer any benefit to the land environment. Interceptor rights-of-way could be managed to provide low level vegetation ("intermediate successional communities") which would serve as small game habitat. An abundance of this type of vegetation does not presently exist in the study area. These interceptors are components of all but the decentralized water-oriented system.

Public Health Risk. All alternatives should reduce microbial contamination over what would be expected under the baseline system. The author of the public health report, however, had reservations about land disposal of wastewater--reservations about "unknown effects on microbial contamination of water courses, on ground water quality, and on health." It could be argued that proper design could reasonably be expected to dispel these reservations. However, the entry in the Impact Evaluation Matrix reflects the reservations as stated in the original report.

CHAPTER II

SOCIAL-ECONOMIC IMPACT STUDY

1.0 STUDY APPROACH

1.1 Objectives

The principal task of this research is to identify significant socioeconomic changes which may result from the implementation of any one of several water pollution abatement schemes. Developed by the U.S. Army Corps of Engineers, each of these strategies could produce marked--and in some cases, dramatic--improvements in the quality of Codorus Creek. For the purposes of this impact analysis, it has been assumed that the strategies are technically feasible; that is, there are no foreseeable engineering problems which would prevent implementation. Moreover, we have attempted to remain neutral toward the treatment technologies contemplated. From the sociological point of view, physical and chemical processes have no intrinsic merit per se. Their desirability derives entirely from the extent to which they do or do not perform well in the Codorus Basin, York County, Pennsylvania.

More specifically, this analysis should:

(1) Array for a range of decision-makers the social and economic implications of alternative pollution solutions, and

(2) Stimulate constructive comment.

The first objective is a product of hindsight. As a society, we now recognize that technology is a two-edged sword. Injudiciously applied--even to the worthiest of causes--it can generate as many new problems as it solves; the post-lunar shakeout in the aerospace industries is a case in point. Therefore, this study seeks to identify possible undesirable consequences before irrevocable decisions on implementation are made. Clearly, that identification cannot be exhaustive, but it can at least flag areas in which further analysis should be performed.

The second objective suggests that such analysis is properly the function of many different interest groups. All the alternatives are flexible. They can accommodate rational local priorities as well as long-range regional goals. But technical plans cannot evolve

positively until there is a public discussion of the issues involved. For pollution control is the product of social forces as much as it is of "black boxes." Too often, otherwise sound environmental management schemes have been the victims of conflicting political and institutional interests. Therefore, to strengthen the ultimate technical plan which will make Codorus Creek a clean stream, we wish to promote dialogue.

1.2 Plan of Analysis

The business of impact analysis is still more an art than a precise science. Despite the efforts of social scientists to build rigorous behavioral models, the complexity of relationships between human beings continues to defy quantification. Like the ecosystem itself, societal interactions form a seamless web. To pluck any part of that web sets up vibrations felt and then echoed throughout it. Thus, to determine with certainty what changes will occur with a given strategy is a task for the soothsayer. What is possible is some educated forecasting based on available data and sound intuitive thinking. To structure that thinking, we have used a three-dimensional matrix composed of the following elements:

(1) Sub-areas of the Codorus Basin, urban and semi-urban, where changes are predictably largest and most immediate,

(2) Technical alternatives and their component unit processes, and

(3) Impact categories which delineate aspects of community activity.

By considering each solution with respect to relevant impact categories and localizing likely effects wherever possible, we can distinguish the broad contours of social and economic change.

Further, the following nomenclature is used uniformly:

(1) impact: a change, particularly in the social or economic context of community life; characterized

by measures of direction, magnitude, and duration.

(2) community — a body of people having common organization, interests, or purposes.

(3) effect — a judgemental evaluation of an impact, which can vary by opinion groups; positive, neutral, or negative.

(4) alternative — one of three strategies using land and/or water-oriented processes to renovate wastewater; syn. scheme, strategy.

To establish benchmarks against which impacts can be measured, Section 2.1 presents statistical profiles of 13 sub-areas in the Codorus Basin; Greater York, Hanover-Penn Township, Triboro (Red Lion, Yoe, Dallastown), Shrewsbury-Railroad-New Freedom, Hallam, Spring Grove, Glen Rock, Jacobus, Loganville, Seven Valleys, Jefferson, Winterstown, and New Salem. Section 2.2 displays the full roster of impact categories on which the authors have drawn. Section 3.0 then introduces the technical alternatives as construed for this analysis (decentralized, centralized and partially centralized systems, respectively), and Section 4.0 sets out impacts as they relate to the short-term and then long-term development of the Basin. Within impact subsections, a decentralized configuration of plants is compared with present conditions and then with a centralized and a partially centralized treatment system. Whenever appropriate, impacts affecting regions outside the Basin will be noted.

1.3 Caveats

- This document regards "wastewater" as a misleading term for what is a valuable resource material. Used water and its polluting constituents can be husbanded intelligently and re-used to extract multiple benefits from the cost of treatment.

- In those instances where an impact is characterized as positive or negative, the values reflected are those of professional consultants and not necessarily those of the Corps of Engin-

eers or any in-Basin group, public or private. As objectives and priorities vary among community actors, so will opinions on the goodness or badness of a given impact.

- The authors make note of the time and data constraints under which this document was prepared and caution readers that its contents are not intended as prophesy. If they have succeeded only in raising a number of important issues for further public debate, their purpose is well served.

2.0 IMPACT MATRIX ELEMENTS

2.1 Sub-Area Profiles

2.1.1 GREATER YORK

A. Location and Characteristics

- Greater York is composed of a group of municipalities and townships which include York City, West York, York Township, Springettsbury Township, and Dover Borough.
- The Greater York Urban node is located in the center of York County.
- The City of York is bordered on the North by Manchester Township, on the East by Springettsbury Township, on the West by West Manchester Township, and on the South by Spring Garden Township.
- All of the townships surrounding York City have, in the past decade, experienced intensive suburban growth.
- The several tributaries of Codorus Creek join upstream of Greater York to form the main stem which discharges into the Susquehanna.
- The area of Greater York including Springettsbury Township, West York, North York, and the City of York, is 27.13 square miles. The area of Dover Borough is .32 square miles.

B. Population

- In 1970, the population of the Greater York Urban Node was 117,681. An estimated 104,181 of this population resided in the Basin.
- The area is quite densely populated, the City of York being exemplary at 9716.9 persons per square mile; Springettsbury Township had 1,212 persons per square mile in 1970.
- The City of York itself declined 8% population between 1960 and 1970. West York Borough, an urban neighborhood in the center of Greater York, had a 4% decline

in population in the same period. York Township, on the other hand, had a 43% increase in population. Likewise, Dover Township and Springettsbury Township were the recipients of York's out-migration, which was reflected by 63% and 47% increases, respectively, in their populations over the ten-year period.

- Race: In 1970, the population of the City of York was 84.4% white.

C. Economic Base

- In 1967, 42.4% of the 22,401 persons employed in the City of York were employed in manufacturing, 17.9% in retail and wholesale trade, and 36.5% in white-collar occupations.
- The median income of families in 1960 in the City of York was $5,441.
- In the Greater York Area, some 306 manufacturing establishments employ almost 30,000 people.
- In 1970, the greatest industrial employers in the area produced knit outerwear, fabricated wire products, and steam engines.
- In 1967, wages and salaries in the industries ranged from an annual average of $2,423 in Dover to $7,588 in Springettsbury Township.

D. Education

- The enrollment in the Central York Area School District, the West York Area School District, the York Suburban Area School District, and the York Area School District totalled 21,705 students in grades K through 12, in 1971.
- The schools are currently operating at 83% of capacity on the elementary level and 81% of capacity on the secondary level. In Dover, the schools are operating at about 90% of their capacity.

E. Recreation

- In 1968, Springettsbury and Manchester Townships, the area which comprises Northern Greater York, had no urban park area. It was estimated that there would

be a need for 145.3 acres in 1968 and 207.1 acres in 1985.

- In West Manchester and Spring Garden Townships in 1968 there were 119 acres of urban park, compared to the 121.9 acres estimated as required for 1985. The existing 119 acres are in Memorial Park which offers open recreation areas, playing fields and ice skating.

- In the Southern and Northern recreation sectors of Greater York, there was a total, in 1968, of 134.2 acres of neighborhood recreation park, compared to an estimated 329 acres required by 1985.

- In the Greater York area there was a total of 237.4 acres of district recreation area in 1968, compared to the projected requirement for 1985 of 329 acres.

- Nowhere in the Greater York area are there public facilities available for boating, fishing, or swimming.

F. Municipal Finance

- Assessed Valuation:

City of York-	$39,607,280
Springettsbury-	15,189,810
Dover-	866,770

- Tax Rate:*

City of York-	19.3 (assessment ratio of 88%)
Springettsbury-	5.6 " " " 23.1%
Dover-	15 mills/dollar at an assessment ratio of 24.6% in 1967

- Public Revenue:

City of York-	$3,927,784
Springettsbury-	721,002
Dover-	76,300

- Total Net Debt, City of York: $1,661,106

*Tax rates given are based on 1970 data unless otherwise specified. Assessment ratios were drawn from 1967 data. The tax rate is expressed in mills (or .001 dollar) per dollar. This figure where multiplied by the product or market value of the property in question and the the assessment ratio yields the amount of taxes paid.

G. Municipal Services

- The Greater York urban area is served by the York Water Company. Some 177,900 persons, with an average daily per capita consumption of 170 gallons per day, use this system. The system has two surface sources on the South and East branches of Codorus Creek.

- The City of York Sewage Treatment Plant presently serves populations in eight municipalities within the Greater York area. The plant is an activated sludge type with a contact stabilization variation. Its present capacity is 18 MGD. The City has been issued orders by the Health Department to provide additional capacity of at least 8 MGD. Plant expansion is planned for 1971, and treatment improvement is scheduled for 1972.

- The Springettsbury Township treatment plant, opened in July, 1971, has a capacity of 8 MGD and has reduced considerably the load on the facility at York.

- There are a large number of industries in the area which contribute waste to the York Treatment Plant, notably potato chip and paper manufacturers, dairies and metal processing plants. Some of the industries pre-treat their waste before discharging it to the York system. Others treat their own waste and discharge the treated effluent to streams.

2.1.2 HANOVER, PENN TOWNSHIP

A. Location and Characteristics

- Hanover Borough is located on the York-Adams County line in the south west of York County. Penn Township is contiguous with Hanover Borough and, as a result of Hanover's expansion, is growing rapidly.

- The area of Hanover Borough is 3.2 square miles. The area of Penn Township is 13.48 square miles.

- Oil Creek, a tributary of Codorus Creek, flows into Penn Township.

B. Population

- The population of Hanover Borough and Penn Township was 23,777 in 1970. Only 8,900 of that population, however, resided in Codorus Creek Basin.

- In the period from 1960 to 1970, Hanover Borough's population increased only 5%. Penn Township was the recipient of the area's growth, reflected by a 26% increase in population.

- The population density in Hanover is 5,101.6 per square mile and in Penn Township, 524 persons per square mile.

- Race: In 1970, the population in the area was almost 100% white.

C. Economic Base

- Hanover and Penn Township had 82 manufacturing concerns in 1970, employing a total of 7,397 persons, or 31% of the population.

- Their employees received an annual average salary of $4,676.

- The major industries in the Hanover-Penn Township area are yarn spinning mills, footwear factories, and book printers and publishers.

- In 1964, Hanover had no farms, but the surrounding townships, Penn and Heidelburg, had 13,153 acres under cultivation in 117 farms and harvested 8,265 acres of cropland.

- In Penn and Heidelburg Townships in 1964, 34% of farm operators worked 100 days or more off the farm.

- The average per capita personal income of Hanover and Penn Township residents in 1963 was approximately $2,767.

D. Education

- The enrollment in the Hanover Borough School District in 1971 was 2,888.
- The Hanover schools are operating at approximately 84% of capacity.
- Penn Township is in the South West School District, which had a total enrollment of 3,794 in 1971.

E. Recreation

- Hanover had, in 1968, 80 acres of urban park. Pigeon Hill Park offers the residents of the area camping and picnicking facilities in addition to the usual open field recreation facilities. It was projected that the area would need 20 additional acres of urban park by 1985.
- Penn Township, Manheim and West Manheim have a combined 70 acres in neighborhood parks and 78 acres in district recreation park areas. It has been estimated that 81.5 acres will be needed in each category by 1985.
- The Codorus Creek State Park, a portion of which lies in each of the surrounding townships, will eventually contain swimming and boating facilities, which are currently not available in any of the recreation facilities in the area.

F. Municipal Finance

- Assessed valuation of Hanover Borough totalled $19,481,660 in 1970. The assessed valuation of Penn Township was $1,174,490.
- The tax rate in Hanover Borough was 21 mils/dollar, and in Penn Township, approximately 8 mils/dollar - assessment rates of 23.1% and 22.8%, respectively.
- Public Revenue: Hanover--$1,314,877
Penn Twp-$ 269,389
- Total Net Debt: (1966) Hanover--NA
Penn Twp-$22,250.

G. Municipal Services--Water and Sewerage

- The Hanover Municipal Water Works provides water to the 28,000 inhabitants of the Hanover-Penn Township node. The average daily consumption of water is 111 gallons per capita. There are two surface sources on the South Branch of the Conewago which serve as the out-of-basin water supply.

- Hanover Borough has a sewage treatment plant which is located to the west of the Borough in Adams County. The extensive system which sewers the Borough includes seven pumping stations. The treatment plant, which is of the bio-filter type, is designed to provide 85% BOD removal. The plant has a capacity of 2.5 MGD and present loadings average 2.0 MGD. The plant discharges treated effluent to Plum Creek, a tributary of Conewago Creek. Sludge from the plant is digested and then spread on drying beds. Conewago Township, which may begin to use the Hanover system, would increase the population using the system by 3,500.

- There are two industrial plants in the borough which have their own treatment plant. The treated effluent from these industries is discharged into Oil Creek.

- The Penn Township treatment plant, located on Oil Creek, is a contact stabilization type with a capacity of 1.75 million gallons a day. Sludge is returned to stabilization tanks for aeration and then used as a seed in the aeration tanks. Excess sludge is used after stabilization as fertilizer. Treated effluent is discharged to Oil Creek.

- The Codorus Creek State Park, which is in the early stages of development, will have an extensive gravity collection sewerage system, the pumping station for which will be constructed by Penn Township. The reservoir which will be located in the Park is a joint venture of P. H. Glatfelter and the Pennsylvania Department of Forest and Waters. There will be an impoundment of 1,275 acres, which will be regulated to insure a minimum flow of 32.4 million gallons a day at Spring Grove, a considerable portion of which will be used by the paper company.

- In addition, there is one industrial operation in the township which operates a treatment plant for the removal of oils from plant waste which it discharges into Oil Creek. It also discharges domestic and industrial waste to the Penn Township system.

2.1.3 RED LION, YOE, DALLASTOWN URBAN NODE - TRIBORO

A. Location and Characteristics

- Red Lion, the second largest borough in the county, Yoe, and Dallastown comprise an urban area called Triboro.
- The Triboro area is located southeast of York City in York Township, with Red Lion on the Eastern boundary of the township.
- The combined area of Triboro is 2.4 square miles, with Yoe considerably smaller, at .21 square miles, than Red Lion or Dallastown.
- An eastern tributary of Codorus Creek, Mill Creek, flows Between Dallastown-Yoe and Red Lion.

B. Population

- In 1970, the population of Triboro was 9,995, an estimated 7,979 of which are in the Codorus Creek Basin.
- Between 1960 and 1970, the Triboro area experienced near population stability with a growth rate of 2 - 2 1/2%.
- The population density of the area is 4,164.5 persons per square mile, with Red Lion being the most densely populated of the three boroughs.
- Race: The Triboro area is almost 100% white.

C. Economic Base

- In 1970, 22% of the Triboro population was employed in a total of 52 manufacturing establishments, which in 1967 paid average annual wages of $4,509 (Red Lion), $4,637 (Dallastown), and $3,803 (Yoe).
- The major industries in the Triboro area manufacture ammunition, except for small arms, and wood household furniture.
- In the surrounding York Township, there were 186 farms in cultivation in 1964. These farms totalled some 11,670 acres, 7058 of which were harvested cropland.
- In 1964, 50% of the farm operators in York Township were working off the farm, 40% for 100 days or more during the year.

- In 1963, residents of Red Lion, Dallastown and Yoe had an average per capita personal income of $2,682 per year.

D. Education

- The Red Lion Area School District has an enrollment of 5,021. Yoe is in the Dallastown Area School District, which has a total enrollment of 9,608.

- The capacity of the schools in Dallastown and Red Lion boroughs are functioning almost at capacity. The elementary schools are 91% full, and the secondary schools are slightly overcrowded.

E. Recreation

- In 1968, there were 45.5 acres of neighborhood recreation park in York and Springfield Townships and 23 acres of district park land. It was estimated that by 1985 the population would require 68.7 acres each of neighborhood recreation park and district park, requiring a total land acquisition of 68.8. acres for recreation.

- Red Lion Borough is in another sector with regard to recreation statistics. At its high school and junior high, in 1968, Red Lion had 27.5 acres of recreation area.

- In 1966, there was no land in the Triboro area devoted to urban parks.

- The existing recreation area is comprised of open recreation area with playgrounds and/or playing fields and an occasional tennis or basketball court. There are no facilities in the area for water sports.

F. Municipal Finance

- The assessed valuations of the Triboro area are:

Red Lion:	$5,913,940
Dallastown:	2,755,630
Yoe:	440,880

- The tax rates for the Triboro area are:

Red Lion:	24.5 mils/dollar	, at assessment ratio of 26.7%
Dallastwon:	19 mils/dollar	, at assessment ratio of 23.6%
Yoe:	10 mils/dollar	, at assessment ratio of 23.4%

•	Public Revenue:	Red Lion:	$ 524,981
		Dallastown:	77,583
		Yoe:	10,943
•	Debt:	Red Lion:	$91,623
		Dallastown:	18,000
		Yoe:	2,000

G. Municipal Services--Water and Sewerage

- The Triboro area is served by the Red Lion Municipal Water System, which is used by some 9,000 people. The average per capita rate of water consumption is 156 gallons daily.

- The waterworks draw water from two out-of-basin surface sources, one at Cabin Creek and the other at Beaver Creek.

- Neither Dallastown nor Yoe have municipal sewers, treatment facilities, or industrial waste treatment plants. In both boroughs the soils appear to be well suited for on-lot disposal. Both boroughs have been cited by the Pennsylvania Department of Health as having in excess of 10% malfunctions of on-lot sewage disposal systems.

- Red Lion Borough is served by an extensive public sewerage system. There are approximately 22 miles of sewerage collection pipes and seven pumping stations. Inadequate dewatered sludge in incinerated at the treatment plant. The treatment plant occasionally has problems resulting from a very high BOD concentration in the waste and lower than expected flows.

2.1.4 SHREWSBURY, RAILROAD, AND NEW FREEDOM

A. Location and Characteristics

- Shrewsbury Borough, Railroad Borough and New Freedom Borough comprise an urban development in Southern York County.
- All three boroughs which comprise this development are in Shrewsbury Township.
- New Freedom Borough has as its southern border the Pennsylvania-Maryland line.
- The combined area of the three boroughs is 4.35 square miles, with Shrewsbury the smallest at .35 square miles and Railroad Borough at .66 square miles.
- The South branch of the Codorus Creek flows along the western extremity of Railroad and New Freedom Boroughs.

B. Population

- The urban node which is composed of Shrewsbury, Railroad and New Freedom Boroughs has a population of 3,519. 2,232 of that number reside in the Codorus Creek Basin.
- In the period from 1960 to 1970, Shrewsbury Borough had a 33% increase in population primarily due to recent annexations from Shrewsbury Township and residential development. Railroad experienced a less than 1% increase and New Freedom a 4% increase in population in the same period.
- The population density of Shrewsbury is 3,585.7 persons per square mile. There were 416.6 persons per square mile in Railroad Borough and 434.1 persons per square mile in New Freedom Borough.
- Race: In 1970, the population of the area was almost 100% white.

C. Economic Base

- In 1970, Shrewsbury, New Freedom, and Railroad had a total of 20 manufacturing establishments which employed 28% of the population of the area.
- In 1966, average salary for those employed in manufacturing in Shrewsbury was $3,897 annually and in New Freedom, $5,291 annually.
- The primary industries in the area produce plastic products and processed foods.

- The average per capita personal income for the area was $2,665 in 1963.

- There were no farms in the boroughs themselves in 1964. In Shrewsbury Township, however, there were some 152 farms cultivating 20,133 acres, 13,950 acres of which were harvested cropland.

- In Shrewsbury Township, 31% of the farm operators were working off the farm 100 days or more in 1964.

D. Education

- New Freedom, Shrewsbury and Railroad Boroughs are in the South York County Area School District which has a total enrollment of 2,415 students.

- The schools in Shrewsbury and New Freedom were operating at 81% of capability in 1971.

E. Recreation

- In 1968, Shrewsbury and Codorus Townships had 45 acres of neighborhood and 20 acres of district recreation area. In addition to the usual open area recreation facilities, there were several facilities with tennis or basketball courts. Nowhere in the townships are there any public water sport facilities, either swimming, boating, or fishing.

- The projected acreage needed for neighborhood recreation parks by 1985 was 27.1 acres, almost 18 acres less than what existed in 1968. An additional seven acres were projected as needed for district recreation parks by 1985.

F. Municipal Finance

- The assessed valuations for the boroughs are:

New Freedom:	$1,747,100
Railroad:	188,750
Shrewsbury:	1,794,100

- The tax rates for the boroughs in 1971 are:

New Freedom:	9.5 mils/dollar	, at assessment ratio of 23.7%
Railroad:	10.0 mils/dollar	, at assessment ratio of 25.9%
Shrewsbury:	11.0 mils/dollar	, at assessment ratio of 25.4%

- Public Revenue:

New Freedom:	$68,746
Railroad:	6,686
Shrewsbury:	44,408

- Debt: New Freedom: $12,000
  Shrewsbury: NA
  Railroad: NA

G. Municipal Services--Water and Sewerage

- The Shrewsbury Municipal Waterworks, which has four well and three spring sources, provides water for 2,000 residents of the Shrewsbury Borough area who consume an average of 60 gallons of water each, daily.

- The New Freedom Municipal Waterworks provides water from six wells to 1,400 people who consume an average of 179 gallons of water each, daily.

- The Railroad Borough Water Company provides water to an additional 300 people from one well and two spring sources.

- Neither Shrewsbury, Railroad nor New Freedom Borough has municipal sewerage of treatment facilities. All three boroughs have been cited by the Pennsylvania Department of Health as having in excess of 10% malfunctions with the on-lot disposal systems. Generally, the soils are good for on-lot disposal in all three boroughs.

- Water from the three boroughs drains into the South Branch of Codorus Creek and its unnamed tributaries and the Lower Susquehanna and Deer Creek (from Shrewsbury) and Beetree Run (from New Freedom).

- There are several industries in the area; one of these spray-irrigates its effluent, another hauls its waste by tank truck to the Glen Rock sewerage system, and a third treats its waste before discharging it to an unnamed tributary of the South Branch of Codorus Creek.

- In August of 1968, orders were issued by the Sanitary Water Board to New Freedom Borough to construct a municipal sewerage treatment and collection plant which was to be located in the South Branch of Codorus Creek in the Northwestern portion of the Railroad Borough so it could serve New Freedom, Railroad, and Shrewsbury Boroughs. The proposed plant was designed for a capacity of 1.3 MGD, utilizing the contact stabilization type process.

2.1.5 HALLAM

A. Location and Characteristics

- Hallam is located on U.S. Route 30 in Eastern York County, just outside Codorus Creek Basin.
- Hallam is very small at .17 square miles.
- Kruetz Creek and its unnamed tributaries drain the Hallam area.

B. Population

- Hallam had a population of 1,825 in 1970.
- During the period between 1960 and 1970, the population of Hallam increased by 50%.
- The density for the Borough of Hallam is very high at 8,676.5, due to its very small area.
- Race: In 1970, the population of the Borough was almost 100% white.

C. Economic Base

- In 1970, 19% of the Borough's population was employed by four manufacturing establishments.
- In 1966, industrial workers received an average annual wage of $3,970.
- The primary industrial employer in Hallam in 1970 manufactured aluminum castings (358 employees).
- 58% of the farm operators in Hallam Township worked off the farm 100 days or more in 1964.
- The average per capita personal income for Hallam residents was $2,557 in 1963.

D. Education

- Hallam is in the East York Area School District which has an enrollment of 2,930 students.
- The Hallam schools had a capacity of 642 and an enrollment of 546 in 1970; the Borough's schools are operating at 85% of capacity.

E. Recreation

- In 1968, Hallam and Lower Windsor Townships had 40 acres of district recreation area and 15.5 acres of neighborhood recreation park area. The projected requirement of the area for 1985 was 34.6 acres in each category indicating a need for 19 acres of additional neighborhood recreation park and a surplus of 5.4 acres of district recreational land.

F. Municipal Finance

- Assessment: $1,542,110
- Tax Rate: 10 mils/dollar at an assessment ratio of 23.3%
- Public Revenue: $24,630
- Debt: NA

G. Municipal Serivces--Water and Sewerage

- Hallam Borough has no public sewers, private or industrial waste treatment plants. The soils are very poor for on-lot disposal due to extensive limestone deposits. The Health Department has cited Hallam as having in excess of 10% of dwellings with malfunctioning septic tanks.

2.1.6 SPRING GROVE BOROUGH

A. Location and Characteristics

- Spring Grove Borough is located midway between the City of York and the urban Borough of Hanover. It is surrounded by North Codorus and Jackson Townships.
- The Borough is very small at .28 square miles.
- The main branch of the Codorus Creek follows the southern and eastern boundaries of Spring Grove Borough.

B. Population

- In 1970 the population of Spring Grove was 1,669.
- Over the past 10 years, the population of Spring Grove has increased 24%.
- The population density of Spring Grove Borough is 7410.7 persons per square mile.
- Race: In 1970, Spring Grove Borough was almost 100% white.

C. Economic Base

- In 1970, 1,121 persons, or 67% of Spring Grove's population, worked in manufacturing.
- The major source of employment in Spring Grove is the P. H. Glatfelter Company, which produces bleached kraft papers and employs some 1081 persons, or 65% of the population.
- In 1967, those employed in industry received an average of $8,886 annually in wages and salary.
- Spring Grove had five farms in 1964, with 975 acres under cultivation, 547 acres of which resulted in harvested cropland.
- In the surrounding counties, North Codorus and Jackson, 47% and 43% of farm workers, respectively, worked off the farm 100 days or more on 1964.
- In 1963, the per capita personal income of Spring Grove residents was $2,602.

D. Education

- There were a total of 3,908 children enrolled in school in the Spring Grove Area School District in 1971. The schools in Spring Grove are functioning at 98% of their capacity.

E. **Recreation**

- Spring Grove Borough has approximately 21 acres of recreation area, all of which is on school property. The four townships which surround Spring Grove have 14 acres of district park area and 44 acres of neighborhood park area. The need for recreation area has been projected to be 49.4 acres of district park and neighborhood park, each, in 1985.

F. **Municipal Finance**

- Assessed Valuation: $2,979,190
- Tax Rate: 16 mils/dollar - assessment ratio of 21.8%
- Public Revenue: $125,197
- Debt: NA

G. **Municipal Services--Water and Sewerage**

- The Spring Grove Water Company provides water drawn from Lake Lehman to 2,000 persons in the Spring Grove area, each of whom consumes an average of 100 gallons of water daily.

- The P.H. Glatfelter Company receives water from the Spring Grove Water Company, which draws its water from the West Branch of Codorus Creek.

- Spring Grove has public sewers and a secondary treatment plant which discharges treated effluent to the West Branch of the Codorus Creek. The plant, which serves about 1,665 persons, at approximately 545 connections, has a design capacity of 245,000 GPD. The plant currently operates at an average flow of 105,000 GPD.

- The P.H. Glatfelter Paper Company operates its own industrial waste treatment facility which is located south of the Borough in North Codorus Township.

2.1.7 GLEN ROCK BOROUGH

A. Location and Characteristics

- Glen Rock is located in Southern York County in the Northwest corner of Shrewsbury Township.
- The South Branch of the Codorus Creek flows through Glen Rock from to the Boroughs of Railroad and New Freedom.
- The area of Glen Rock Borough is .55 square miles.

B. Population

- In 1970, the population of Glen Rock was 1,600.
- In the last decade, Glen Rock Borough's population has increased by 5%.
- The population density of Glen Rock Borough is 2,954 persons per square mile.
- Race: The Borough of Glen Rock was almost 100% white in 1970.

C. Economic Base

- In 1970, over 1,000 persons worked in manufacturing establishments in Glen Rock.
- In 1966, those employed by the seven manufacturing establishments in Glen Rock Borough earned an average annual wage of $4,509.
- In 1970, the primary manufacturing industries in Glen Rock produced current-carrying wiring devices (688 employees).
- There were no farms in Glen Rock Borough in 1964. In the surrounding area, Shrewsbury Township, there were 38,303 acres comprising 152 farms, which produced 13,950 acres of harvested croplands.
- In Shrewsbury Township, 31% of farm operators worked off the farm 100 days of more in the year, in 1964.
- In 1963, Glen Rock residents had a per capita average personal income of $2,666.

D. Education

- In 1971, the total school enrollment for the South York Area School District, which includes Glen Rock Borough, was 2,415.

- The capacity of the elementary schools in Glen Rock was 780, compared to an enrollment of 560, in 1970. Thus, the schools were operating at 75% of capacity. The secondary schools with enrollment at 1341, compared to a capacity of 15801, were operating at 85% of their capacity.

E. Recreation

- In 1968, there were approximately 5.5 acres devoted to recreation in Glen Rock Borough. These are located at the elementary school, which has a basketball or tennis court in addition to the usual open play recreation area, and at a recreation area which offers ice skating.

F. Municipal Finance

- The assessed valuation of Glen Rock Borough in 1971 was $1,225,630.
- Tax Rate: 14 mils/dollar - assessment ratio of 22.6 (1971)
- Public Revenue: $65,034.
- Net Debt: NA

G. Municipal Services--Water and Sewerage

- The Glen Rock Water Authority provides water to 1,600 people who consume an average of 82 gallons daily per person.
- The Borough has a complete sewerage system and its own treatment plant which is located along the South branch of Codorus Creek. The plant employs the contract stabilization process, followed by a polishing lagoon. Presently, the plant is operating at full capacity, which is .3 MGD. Sludge is removed by tank truck monthly to nearby farms for application as a soil conditioner

2.1.8 JACOBUS BOROUGH

A. Location and Characteristics

- Jacobus Borough is in Springfield Township, south of the Greater York Metropolitan Area. It is separated from Greater York by Lake Williams and the York Company Reservoir.
- The East Branch of the Codorus Creek flows just to the north and east of the Borough's bounderies.
- The area of Jacobus is .75 square miles.

B. Population

- In 1970 the population of Jacobus was 1,369.
- Between 1960 and 1970 the population of the Borough increased by 40%.
- The density of the Borough is 1,800 persons per square mile.
- Race: In 1970 Jacobus was 100% white.

C. Economic Base

- In 1970 there were only two manufacturing establishments employing a total of 32 persons in Jacobus.
- In 1964, there were four farms in Jacobus with a total of 88 acres under cultivation.
- In 1964, 45% of the farm operators in Springfield Township worked off the farm 100 days or more.
- The average per capita annual personal income for residents of Jacobus in 1963 was $2,361.

D. Education

- Jacobus is in the Dallastown Area School District which in 1971 had a total enrollment of 4,608 students.
- The capacity of the Jacobus schools in 1971 was 120 compared to the current enrollment of 92. The Jacobus School is operating at 77% of its capacity.

E. Recreation

- Jacobus had 7.5 acres of neighborhood recreation park in 1968. In addition to the usual open space recreation facilities, the recreation area, associated with the elementary school, had basketball or tennis courts.

F. Municipal Finance

- Assessed Valuation: $1,525,400
- Tax Rate: 6 mils/dollar, at an assessment ratio of 23.5%
- Public Revenue: $18,944
- Debt: NA

G. Municipal Services

- There are no municipal collection systems, municipal treatment facilities, or industrial waste treatment plants in the Borough. The soils are generally good for on-lot disposal. A joint sewerage collection and treatment system is being contemplated for Jacobus, Loganville Borough, and Springfield Township.

2.1.9 LOGANVILLE

A. Location and Characteristics

- Loganville is located in south central York County, in Springfield Township.
- The area of Loganville is .42 square miles.

B. Population

- The population of Loganville Borough in 1970 was 921.
- This reflects a 13% increase over the 1960 population.
- The population density in the Borough was 1,988.1 persons per square mile.
- Race: Loganville Borough was 100% white in 1970.

C. Economic Base

- In 1970, Loganville had two manufacturing establishments with a total of eight employees.
- In 1966, Loganville had eight farms with a total of 257 acres.
- 45% of the farm operators in Springfield Township worked off the farm 100 or more days in 1964.
- The average per capita personal income for Loganville residents in 1963 was $2,854.

D. Education

- Loganville is in the Dallastown Area School District which had a 1971 enrollment of 4,608.

E. Recreation

- In 1968 Loganville had 14 acres of neighborhood recreation area associated with its elementary school. York and Springfield Townships, which comprise the recreation sector of which Loganville is a part, had a total of 45 acres of neighborhood recreation area and 23 acres of district recreation park area.

F. Municipal Finance

- Assessed Valuation: $764,080
- Tax Rate: 8 mils/dollar - assessment ratio of 22.0%
- Public Revenue: 24,419
- Debt: NA

G. Municipal Services--Water and Sewerage

- Four wells supply 800 persons in Loganville with 88 gallons of water each per day.
- Loganville has no municipal private or industrial treatment facilities. A joint sewage system with Jacobus Borough and Springfield Township being considered. Soils in Loganville are excellent for on lot disposal.

2.1.10 SEVEN VALLEYS BOROUGH

A. Location and Characteristics

- Seven Valleys is a small borough located in Southern York County on the South Branch of the Codorus Creek.
- The area of Seven Valleys is .86 square miles.

B. Population

- In 1970 the population of Seven Valleys Borough was 688.
- In the period between 1960 and 1970 the population of Seven Valleys increased only 5%.
- The population of the Borough density is 627.9 persons per square mile.
- Race: In 1970 Seven Valleys Borough was almost 100% white.

C. Economic Base

- In 1970, 28% of the Seven Valleys Borough population worked in manufacturing. The major employer produces clothing and employs some 190 persons.
- In 1966 there were five farms in Seven Valley cultivating a total of 976 acres.
- Approximately 46% of the farm operators in the surrounding Springfield and North Codorus Township worked off the farm 100 days or more in 1964 .
- The average per capita personal income for the residents of Seven Valleys Borough was $3,052 in 1963.

D. Education

- Seven Valleys is in the Spring Grove Area School District which had an enrollment of 3,908 in 1971.
- The capacity of the Seven Valley Borough schools in 1971 was 264 compared to an enrollment of 233. The School was operating at 88% of its capacity.

E. Recreation

- The Seven Valleys Elementary School had, in 1968, 7.0 acres of neighborhood recreation area offering the usual playing fields, play apparatus and open space recreation.

F. Municipal Finance

- Assessed Valuation: $378,738
- Tax Rate: 12 mils/dollar - assessment ratio of 24.5%
- Public Revenue: $11,423
- Total Net Debt: $ 8,500

G. Municipal Services

- The Seven Valleys Municipal Water Works has one well and six spring sources of supply which it employs to provide water to 230 persons who consume a daily per capita average of 260 gallons.

- There are no municipal or industrial treatment facilities in the Borough. The soils are good for on-lot disposal. The Borough has been cited by the Health Department as having 10% or more malfunctioning on-lot sewage disposal system.

- The Seven Valleys Elementary Center of the Spring Grove Area School District has a sewage disposal plant under permit by the Pennsylvania Department of Health. Presently the plant serves 247 persons. It has a design capacity of 6,300 gallons per day, with 92% BOD removal. The treated effluent is discharged to an unnamed tributary of the South Branch of Codorus Creek.

2.1.11 JEFFERSON BOROUGH

A. Location and Characteristics

- Jefferson Borough is a rural community in the southwest area of the county, in Codorus Township.
- The area of the Borough is .44 square miles.

B. Population

- In 1970 the population of Jefferson was 540.
- In the period between 1960 and 1970 the population of Jefferson remained stable.
- The population density in the Borough is 1022.7 per square mile.
- Race: In 1970 the population of Jefferson was 100% white.

C. Economic Base

- In 1970, 13.5% of the Jefferson population were employed in manufacturing. The sole manufacturing concern in Jefferson Borough produces clothing.
- In 1964, Jefferson had eight farms with a total of 368 acres, 265 of which were cropland.
- 47% of farm operators in North Codorus County worked off the farm 100 or more days in 1964.
- The per capita personal income of residents of Jefferson Borough averaged $2,186 in 1964.

D. Education

- Jefferson is in the Spring Grove Area School District which in 1971 had an enrollment of 3,908 students.

E. Recreation

- In 1968 Jefferson had 2 acres of neighborhood recreation area at its elementary school offering play apparatus and open space recreation.

F. **Municipal Finance**

- Assessed Valuation: $487,910
- Tax Rate: 17 mils/dollar - assessment ratio of 25%
- Public Revenue: $16,904
- Debt: NA

G. **Municipal Services**

- The Jefferson Borough Water Works draws its water from three wells. It supplies 29 gallons per capita daily to 700 people.
- There are no municipal sewers, treatment facilities or industrial waste treatment facilities in Jefferson. At the present time Jefferson is classified by the Health Department as having in excess of 19% malfunctions of on-lot sewage disposal systems. The soils in Jefferson are generally good for on-lot disposal.

2.1.12 WINTERSTOWN BOROUGH

A. Location and Characteristics

- Winterstown is a rural community located in southeastern York County.
- It has an area of 1.38 square miles.

B. Population

- In 1970 the population of Winterstown was 424.
- The growth rate of the Borough between 1960 and 1970 was approximately 21.4%.
- Winterstown Borough is sparsely populated at only 264.5 persons per square mile.
- Race: In 1970, the population of Winterstown was 100% white.

C. Economic Base

- In 1970, 21% of the population of Winterstown was employed in manufacturing. The sole industrial employer in Winterstown produced special dies and tools.
- In 1966, Winterstown Borough had 14 farms which cultivated a total of 1,475 acres, which yielded 1,054 acres of harvested cropland.
- In North and East Hopewell, 35% of farm operators worked off the farm 100 days or more in 1964.
- The average annual per capita personal income for the residents of the Borough was $2,507 in 1963.

D. Education

- Winterstown is in the Red Lion Area School District which had an enrollment of 5,021 students in 1971.

E. Recreation

- Winterstown itself has 5.0 acres of neighborhood park associated with the elementary school. The very large recreation sector of which it is a part (Windsor, Chancelford, Lower Chancelford, and North Hopewell Townships). This group of townships had 39

acres of District recreation park acreage in 1968 and 50 acres of neighborhood park recreation area.

F. Municipal Finance

- Assessed Valuation $235,000 in 1967
- Tax Rate 5.0 mils/dollar - assessment ratio of 25.2% (1967)
- Public Revenue : $3,981
- Total Net Debt: $750

G. Municipal Services

- There are no municipal or industrial sewerage collection or treatment facilities in the borough. The soils in the borough are generally good for on-lot disposal. The 1961 malfunctioning septic systems in Winterstown were just below the level at which the Health Department issues citations.

2.1.13 NEW SALEM BOROUGH

A. Location and Characteristics

- New Salem Borough is located just southwest of the Greater York area in North Codorus Township.
- The area of New Salem is .33 square miles.
- The West Branch of Codorus Creek flows through the western corner of New Salem.

B. Population

- In 1970 the population of New Salem was 384.
- The population density of New Salem is 1,242.4 people per square mile.
- Race: New Salem was almost 100% white in 1970.

C. Economic Base

- In 1970 there were no manufacturing establishments located in New Salem.
- In 1964, New Salem had 6 farms with 252 acres under cultivation, 116 of which were harvested cropland.
- In 1964, 47% of the farm operators in North Codorus Township worked off the farm 100 days or more.
- The average per capita personal income of residents of New Salem Borough in 1963 was $2,606.

D. Education

- New Salem Borough is in the Spring Grove School District which had a total enrollment of 3,908 students in 1971.

E. Recreation

- The York-New Salem Elementary School has 7.0 acres of neighborhood recreation area.

F. **Municipal Finance**

- Assessed Valuation: $377,320
- Tax Rate: 15 mils/dollar - assessment rate of 20.5%
- Public Revenue: $25,257
- Total Net Debt: $9,000

G. **Municipal Services**

- Four well sources and one spring source provide 6,000 gallons of water a day to 1,500 people in New Salem.
- There are no municipal collection or treatment facilities in New Salem. The soils are generally good for on-site disposal.

2.2 Impact Assessment Structure

The table on the following pages identifies the categories which are considered significant for identifying impacts in the Codorus Basin. Within each category, impacts can be felt along a number of different dimensions; hence, different measures have been suggested for each. While it has been impossible to quantify changes for so many technical alternatives, vectors for the direction, magnitude, and duration of impacts can be constructed. Thus, Section 4.0 is organized according to short-term and long-term changes. The former is defined as those impacts likely to occur during the construction phase; long-term impacts are those which will not be felt until a system is operational and water quality in the Codorus begins to improve. Once supplied with an indication of how Basin residents value the activities represented in the chart, it will be possible to evaluate the aggregate effect of a proposed treatment system.

Impact Category	Suggested Measures	Units
1. Land Use	Net change in the percent distribution of acres devoted to industrial, commercial, residential, recreational and other land uses.	Percent
	Number of feet of incompatible land uses separated by the facility, minus the number of feet of compatible uses separated	Feet
	Net change in the amount of land available for development	Acres
2. Population	Net changes in the age, income, race and ethnicity distributions of the local population	Percent
3. Municipal Finance	Loss of assessed valuation as a percent of community total	Percent
	Increase in assessed valuation resulting from improved water quality	Dollars
	Net change (gain/loss) in tax revenue resulting from improved water quality	Dollars
4. Housing	Net change (increase/decrease) in number of housing units by number of bedrooms by price. (OR)	Number
	As a percent of community's total stock	Percent
5. Education	Net change in amount of classroom and other educational space required for projected change in school-age population resulting from in- and out-migration.	Sq. Feet
	Net change in cost of teacher and other education staff required for projected change in school-age population resulting from in- and out-migration	Dollars
	Net change in cost of providing school services because of changes in busing	Dollars
	Use of treatment plant facilities for educational programs	Days/Year

6. **Leisure Opportunities**	Net change in the total number of acres of parks and playgrounds in the Environmental Management Area	Acres
	Net change in the extent to which planned recreation space meets American Society of Planning Officials planning standards relating types of space to population characteristics	Percent
7. **Cultural Opportunities**	Total number of churches, historical sites or other cultural institutions taken	Number
	Cost of relocating churches, historical sires and other cultural institutions, minus compensating payments	Dollars
	Increase in locational amenities (eg., improved site planning, additional parking, etc.,) as a result of relocation	Number of Improve-ments
8. **Transportation**	Net change in travel time from major residential areas to activity centers: health, commercial, recreation, employment, education, cultural	Minutes/ Trip x Trips/Day
9. **Municipal Services**	Net change in cost of providing water, sewerage, and garbage service	Dollars
	Net change in cost of providing police and fire protection	Dollars
	Net change in residential heating costs	Dollars
	Net change in residential insurance rates	Percent

Impact Category	Suggested Measures	Units
10. Security	Change in the number of reported crimes against the person or against property within sight of the control facility	Number
	Number of positive and negative statements about the opportunities for system failure, as revealed by a content analysis of local news media	Number
11. Community Image	Changes in property values along river	Dollars
	Changes in property values adjacent to treatment facility	Dollars
	Number of positive and negative statements about the community as revealed by a content analysis of local news media	Number
12. Community Cohesiveness	Total number of community groups taking a position (making a public statement) for or against the treatment facility	Number
13. Citizen Involvement	Total number of community groups involved in the planning of the project, times the level of their involvement, according to the following scale of increasing involvement:	Weighted Number
	1. attendance at hearing; 2. citizen opportunity to critique plans at public meetings; 3. periodic workshop planning sessions with community representatives; 4. community advocate planner participates on equal basis with technical staff in all planning activities; 5. appointment of arbitrative hearing officer who makes final decision in case of dispute between community and Army engineers	
14. Institutional Relationships	Total number of jurisdictions involved in the totality of the construction process for a treatment facility	Number
	Number of enforcement actions brought against non-compliant offenders; municipal, industrial	Number

Impact Category	Suggested Measures	Units
15. Economic Stability	Net change in income resulting from construction and related activities	Dollars
	New increase in private investment	Dollars
16. Real Income	Net change in per capita income	Dollars
	Net change in tax assessments	Dollars
	Net change in regional net income	Dollars
17. Employment	Number and type of jobs created/lost	Number
18. Industrial Activity	Change (increase/decrease) in number of industrial establishments	Number
	Change in productivity indices	Dollars
19. Agricultural Activity	Change (increase/decrease) in number of farm acres	Number
	Change in production per acre	Dollars
20. Commercial Activity	Net change over normal trends in gross wholesale and retail sales	Dollars
	Net number of businesses located (displaced) by central facility	Number

3.0 TECHNICAL ALTERNATIVES

3.1 Decentralized, Water-oriented System[1] Quality Level B

Selection Criteria:

1. Conforms to present implementation plan administered by the Commonwealth of Pennsylvania.
2. Simplifies institutional relationships.
3. Represents the least cost solution to meeting present Commonwealth standards.
4. Recognizes the economies inherent in combining urban and semi-urban places into single service areas.
5. Does not substantially alter the hydrologic regime of the Codorus Basin.

Design Criteria:

Municipal and industrial flows projected to 2000 with no treatment contemplated for storm or agricultural runoff. All treated effluent is considered to have undergone contact stabilization, clarification, 80% phosphorus removal, filtration, and reaeration and chlorination.

Structural Components:[2]

Basic Treatment: 9 AS required $\begin{cases}\text{9 existing}\\ \text{1 proposed}\\ \text{1 abandoned}\end{cases}$

Existing facility at P.H. Glatfelter

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[1] This alternative was previously designated II, with Options 1 and 3 representing water quality levels B and D, respectively.

[2] The following notation system applies uniformly:

AS .... secondary (activated sludge) treatment plant
T .... tertiary treatment facility providing any unit process beyond AS (biological)
PS .... pumping station
L .... land application site with associated storage lagoon and well-field
R .... raw sewage
2x .... secondary treated effluent
80(98)P .... effluent in which 80% (98%) phosphorus removal has been achieved
3x .... full tertiary treated effluent

Advanced Treatment:[3]	9 T structures required	8 additions to existing plants 1 entirely new facility
Transmission:	3 new interceptor systems 2 short connectors to existing lines 5 PS	
Solids Handling:	All plants are equipped with digesting and dewatering facilities which prepare sludges for application to the land.	

<u>Area Systems</u>: VII

I. Greater York + Dover + New Salem + Hallam

2 existing AS with proposed T addition, one each at York and Springettsbury, AS at Dover is abandoned.

8-3/4 miles of transmission piping from Dover to York.

2-1/4 miles of transmission piping from New Salem to York.

1-1/4 miles of transmission piping from Hallam to Springettsbury.

II. Red Lion, Yoe, Dallastown + Winterstown

1 existing AS with proposed T addition at Red Lion.

3-1/2 miles of transmission piping from Winterstown to Red Lion.

1 PS at Winterstown.

III. Glen Rock

1 existing AS with proposed T addition.

IV. Shrewsbury, Railroad, New Freedom

1 proposed AS with proposed T addition.

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[3] In this alternative, T includes the addition of alum to achieve 80% phosphorus removal, filtration through sand or graded media, and reaeration increasing DO from 1 mg/l to 6 mg/l.

V. Spring Grove

1 existing AS with proposed T addition P. H. G.
1 existing AS with proposed T[4] addition.

VI. Hanover, Penn Township

2 existing AS with 1 proposed T addition each

VII. Jefferson + Seven Valleys + Loganville + Jacobus

1 proposed AS + T on Codorus South Branch below Seven Valleys.

Discussion:

The alternative does not physically integrate any urban nodes but it does aggregate urban and semi-urban nodes in two cases. The remaining semi-urban places are integrated into a single collection and treatment system.

I. Greater York

R flows from Dover and New Salem are treated by an expanded plant at York and R from Hallam is treated at the facility serving Springettsburg. 2x + 80P effluent is discharged at two existing outfall sites to the main stem Codorus.

II. Red Lion, Yoe, Dallastown + Winterstown

R flow from Winterstown is treated at Red Lion and 2x + 80P effluent is discharged to Mill Creek at existing outfall.

III. Glen Rock

2x + 80P effluent discharged to South Branch at present site.

IV. Shrewsbury, Railroad, New Freedom

2x + 80P effluent is discharged to the South Branch at present site.

V. Spring Grove

2x + 80P effluent discharged to West Branch above current P. H. G. outfall.

P. H. G. effluent (T) discharged to West Branch at present site.

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[4]T as it applied to P. H. Glatfelter adds carbon adsorption for COD and color removal, filtration, reaeration, and cooling to present lime clarification and biological treatment facilities.

VI. Hanover, Penn Township

Hanover - 2x + 80P effluent discharged to Plum Creek in Conewago Basin at present site.

Penn Township - 2x + 80P effluent to Oil Creek at present site.

VII. Jefferson, Seven Valleys, Loganville, Jacobus

2x + 80P effluent discharged to South Branch 1/2 mile below Seven Valleys

<u>Outputs:</u>

Quality of Performance (mg/l) = 2x + 80P

Constituent	Municipal plant	PHG	Constituent	Municipal plant	PHG
COD	45	12			
BOD	7	4	Color	~0	25
SS	3	3	NH_3	17	$\leq$3.5
DS	400	1575	NO_3/NO_2	1	$\leq$7
P	2	.2	N	2	$\leq$2.5

Quantity (MGD)

	1980	2000
I. Greater York	23.5 23.5	38.4 38.4
Springettsbur	6.55	9.8
II. Red Lion, Yoe, Dallastown	1.63	2.7
III. Glen Rock	.24	.50
IV. Shrewsbury, Railroad, New Freedom	.9	1.9
V. Spring Grove	.2	.3
P. H. Glatfelter	23.0	28.0
VI. Hanover	2.7	3.9
Penn Township	1.4	2.2
VII. Jefferson, Seven Valleys Loganville, Jacobus	.36	.52

Re-Uses:

none; all effluent is returned to local surface waters to maintain existing flow patterns.

Costs:

Total capital cost:	$41,957,000
Average annual cost:	$ 8,200,000

(operation and maintenance plus debt retirement)

3.2 Decentralized, Water-oriented System Quality Level D

Selection Criteria:

1. Identical in physical configuration to 3.1 but at a higher quality level.
2. Utilizes sophisticated treatment technologies.
3. Offers dramatic improvements in effluent quality which open water contact sports potentials as well as water supply potentials for receiving waters.

Design Criteria:

Municipal and industrial flows projected to 2000 with no treatment for storm or agricultural runoff. All treated effluent is considered to have undergone contact stabilization, clarification, nitrefication-denitrification, 98% phosphorus removal, recarbonation, filtration, reaeration and chlorination.

Structural Components:

Basic Treatment:	9 municipal AS, P. H. Glatfelter facilities as in 3.1.
Advanced Treatment:	9 municipal T,[5] P. H. Glatfelter facilities as in 3.1.

Transmission and solids handling as in 3.1.

[5] T at this level of treatment goes beyond T at level B with massive lime additions to achieve 90% phosphorus removal and recarbonation with CO_2 from lime recalcination. Media filtration, reaeration and chlorination proceed as before. Acreage requirements for facilities including such additional unit processes are approximately double those for level B, e.g., for 1 mgd 10 acres rather than 4.5. At higher capacities, economies of scale reduce that factor well below 2.

<u>Area Systems</u>: VII, as in 3.1

<u>Discussion:</u>

This alternative differs from 3.1 only in the higher quality of its effluent outputs and the costs associated with larger plants and more staff with higher training.

<u>Outputs:</u>

Quality of Performance (mg/l) = 3x

Constituent	Muni-cipal plant	P. H. G.	Constituent	Muni-cipal plant	P. H. G.
COD	30	12	Color	~0	25
BOD	3	4	NH_3	0	≤ 3.5
SS	3	3	NO_3/NO_2	2	≤ 7
DS	350	1575	N	0	≤ 2.5
P	.2	.2			

Quantity (MGD), as in 3.1.

<u>Re-Uses:</u>

Because the effluent produced by this alternative is "super-clean" by comparison with lower quality levels, high order uses such as full body contact and water supply become possible. Local flow augmentation seems possible only on the main stem through Springettsbury, all other outfalls being located below the principal population center served.

<u>Costs:</u>

Total capital cost: $ 67,715,000
Average annual cost: $ 11,433,000
(operation and maintenance plus debt retirement)

3.3 Centralized, Water-oriented System[6] Quality Level B

Selection Criteria:

1. Offers a regional water treatment system with a type of flexibility not possible under the existing decentralized implementation plan.
2. Requires increased jurisdictional cooperation and more complex institutional arrangements.
3. Apportions heavy investments in transmission lines among communities rather than costs for local treatment plants.
4. Utilizes designs for unit process components with very large capacities.
5. Realizes economies of scale in physically integrating all urban and semi-urban places.
6. Eliminates the wastewater discharge portions of flows above Spring Grove, in the South Branch, and in Mill Creek completely at only slight reductions in flow.

Design Criteria:

Municipal flows projected to 2000 with no treatment contemplated for storm or agricultural runoff. All treated effluent is considered to have undergone contact stabilization, clarification, 80% phosphorus removal, filtration, reaeration, and chlorination.

Structural Components:

Basic Treatment:	2 AS required	2 existing 0 proposed 7 abandoned
	Existing facility at P. H. Glatfelter	
Advanced Treatment:[7]	3 T structures required; 2 additions to existing plant and one wholly new facility.	
	Additional structures at P. H. Glatfelter	

[6] This alternative was previously designated Ib, with Options 1 and 7 representing water quality levels B and D, respectively.

[7] T facilities added to existing AS facilities would perform 80% phosphorus reduction only. The new T at York would provide filtration, reaeration and chlorination before discharge.

Transmission:	5 major new interceptor systems 2 short connectors to existing lines 7 PS
	Flows in all cases will be R, save 2x + 80P between Springettsbury and York T
Solids Handling:	All plants are equipped with digesting and dewatering facilities which prepare sludges for application to the land.

Area Systems: I

I. Greater York + Hanover, Penn Township + Spring Grove + New Salem + Dover + Ia subsystem

2 substantially enlarged AS with proposed T additions, one each at York and Springettsbury.

4 AS at Hanover, Penn Township, Spring Grove, and Dover are abandoned.

1 proposed T at York
P. H. G.: 1 existing AS with a proposed T addition.[8]

22.5 miles of R transmission piping (West Branch Interceptor)
7.5 miles of R transmission piping (Dover Interceptor)
.3 miles of 2x + 80P transmission piping from Springettsbury to York

4 PS

Ia subsystem = Springettsbury + Hallam + Red Lion, Yoe, Dallastown + Winterstown + Shrewsbury, New Freedom, Railroad + Glen Rock + Jefferson + Seven Valleys + Loganville + Jacobus.

3 AS at Red Lion, Railroad, and Glen Rock are

26.5 miles of transmission piping (Jefferson and South Branch Interceptors)
12.75 miles of transmission piping (Winterstown and Mill Creek Interceptors)
2.0 miles of transmission piping (Hallam Interceptor)

3 PS

[8]See Footnote 4.

Discussion:

This alternative integrates all urban and semi-urban nodes completely. It abandons all local plants in the upper basin in favor of an extensive network of feeder systems pumping R to facilities at York and Springettsbury where the influent undergoes 2x + 80P treatment. From the Springettsbury AS, 2x + 8P effluent would go to a new T facility at York; combined flows would receive additional treatment and be discharged at the present outfall site below York.

P. H. Glatfelter would provide clarification, conventional secondary treatment and add carbon adsorption, reaeration, and cooling. T effluent would be discharged to the West Branch Codorus at the present site.

Outputs:

Quality of performance B as in 3.1.

Quantity (MGD)

	1980	2000
York AS	27.8	44.8
Springettsbury AS	9.7	15.4
York T	37.5	60.2
P. H. Glatfelter	23.0	28.0

Re-Uses:

none; effluent returned to surface water at two points, one in West Branch and one below York on the main stem, to balance flows.

Costs:

Total capital cost: $49,185,000
Average annual cost: $ 8,279,000
(operation and maintenance plus debt retirement)

3.4 Centralized, Water-oriented System Quality Level D

Selection Criteria:

1. Identical in physical configuration to 3.3 but at a higher quality level.
2. Utilizes sophisticated technologies at a large scale.
3. Offers dramatic improvements in effluent quality and concentrates large volumes of "super-clean" water at 2 points.

Design Criteria:

Municipal and industrial flows projected to 2000 with no treatment contemplated for storm or agricultural runoff. All treated effluent is considered to have undergone contact stabilization, clarification, nitrification-denitrification, 98% phosphorus removal, recarbonation, filtration, reaeration and chlorination.

Structural Components:

Basic Treatment:	2 municipal AS, P. H. Glatfelter facilities as in 3.3.
Advanced Treatment:	3 municipal T,[9] P. H. Glatfelter facilities as in 3.3.

Transmission and solids handling as in 3.3.

Area Systems: I, as in 3.3.

Discussion:

This alternative differs from 3.3 only in the higher quality of its effluent outputs and the costs associated with larger plants and more staff with higher training.

Outputs:

Quality of performance D, as in 3.2.

Quantity (MGD), as in 3.3.

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[9] The unit processes for this centralized system at level D are identical to those in 3.2 but a single facility performs recarbonation, filtration, reaeration and chlorination. See Footnote 5.

Re-Uses:

Effluent produced by this system is thoroughly clean and consistent with the full range of water uses associated with pristine streams. Its discharge below York would provide a larger flow, but in an area where recreational development is limited largely to riverbank activities by the stream's physical size and meandering nature.

Costs:

Total capital cost:	$ 66,337,000
Average annual cost:	$ 10,351,000

(operation and maintenance plus debt retirement)

3.5 Partially Centralized, Combination Water-Land System Quality Levels D and F[10]

Selection Criteria:

1a. Closely parallels existing state implementation strategy.

1. Introduces land application as an important treatment technology.

2. Distributes completely renovated water throughout upper Basin proximate to local sources of supply.

3. Eliminates long transmission systems.

4. Treats largest of urban flows at their logical point of collection.

5. Produces numerous winter-season water bodies for 2x effluent storage which simultaneously provides back-up storage for heavy fall rains.

6. Preserves large tracts of land allocated for irrigation as open-space.

7. Offers a level of quality not available save with "living-filter" treatment in the vegetative layer of the soil.

Design Criteria:

Municipal and industrial flows projected to 2000 with no treatment contemplated for storm and agricultural runoff. All mechanically treated effluent is considered to have undergone contact stabilization, clarification, nitrification-denitrification, 98% phosphorus removal, recarbonation, filtration, reaeration, and chlorination. Hand-applied 2x effluent is "multi-processed"

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[10] This alternative was previously designated IV.

by the soil; nutrient uptake by soil and vegetation, filtration of suspended solids, adsorption of metals and refractory organics by soil particles, bacteria and virus removal by filtration and adsorption. Renovated 3x is recaptured, reaerated as necessary and distributed as desired.

Structural Components:

Basic Treatment: 11 AS required: 7 existing, 4 proposed, 1 abandoned

Existing facility at P. H. Glatfelter

Advanced Treatment: 2 T structures, each an addition to an existing plant.

9 L sites with a minimum of one storage lagoon and well-field each.

Additional structures at P. H. Glatfelter (see Footnote 4).

Transmission: 2 major interceptors
2 short connectors
Flow in all cases is R

Solids Handling: All plants are equipped with digesting and dewatering facilities which prepare sludges for application to the land.

Area Systems: IX

I. Greater York + Dover + New Salem + Hallam[11]

2 existing AS with proposed T addition, one each at York and Springettsbury; AS at Dover is abandoned.

8-3/4 miles of transmission piping from Dover to York.
2-1/4 miles of transmission piping from New Salem to York.
1-1/4 miles of transmission piping from Hallam to Springettsbury.
3 PS, one each at New Salem and Hallam, one midway between Dover and York.

[11] This area system is identical to that in 3.2 producing D level effluent.

II. Red Lion, Yoe, Dallastown + Winterstown

1 existing AS
1 proposed irrigation site
3-1/2 miles of transmission piping from Winterstown to Red Lion
1 PS at Winterstown

III. Glen Rock

1 existing AS
1 proposed irrigation site

IV. Shrewsbury, Railroad, New Freedom

1 proposed AS
1 proposed irrigation site

V. Spring Grove

1 existing AS
1 proposed irrigation site
P. H. G. 1 existing AS with proposed T addition

VI. Hanover, Penn Township

2 existing AS
1 proposed irrigation site

VII. Jefferson

1 proposed AS
1 proposed irrigation site

VIII. Jacobus + Loganville

1 proposed AS
1 proposed irrigation site

IX. Seven Valleys

1 proposed AS
1 proposed irrigation site

Discussion:

This alternative utilizes water-oriented technologies to provide complete basic and advanced treatment for wastewater flows in the Greater York urban area. In the upper basin, R flows become 2x in conventional biological (secondary) plants and then 3x in the land by infiltration, with collection and discharge to local surface waters. P. H. Glatfelter continues to provide water-oriented treatment as in previous alternatives.

I. Greater York

R flows from Dover and New Salem are treated by an expanded plant at York and R from Hallam is treated at the facility serving Springettsburg. 2x + 98P effluent is discharged at two existing outfall sites to the main stem Codorus.

II-IX. R flows receive secondary treatment locally and full tertiary treatment in the soil medium. Discharges of 3x effluent, recaptured and monitored, are to local surface waters in all cases.

Outputs:

Quality of performance (mg/l) = 3x(D) or 3x(F)

D level as in 3.2

F level:

Constituent	Municipal plant	P. H. G.	Constituent	Municipal plant	P. H. G.
COD	5	12	Color	0	25
BOD	3	4	NH_3	0	≤ 3.5
SS	~0	3	NO_3/NO_2	2	≤ 7
DS	400	1575	N	0	≤ 2.5

Quality (MGD), as in 3.1

	1980	2000
I. Greater York		
York	23.5	28.4
Springettsbury	6.66	9.8
II. Red Lion, Yoe, Dallastown	1.63	2.73
III. Glen Rock	.24	.50
IV. Shrewsbury, Railroad, New Freedom	.9	1.9
V. Spring Grove	.2	.3
P. H. Glatfelter	23.0	28.0

continued:

		1980	2000
VI.	Hanover	2.7	3.9
	Penn Township	1.4	2.2
VII.	Jefferson	.04	.04
VIII.	Jacobus + Loganville	.26	.41
IX.	Seven Valleys	.06	.07

Re-Uses:

The extremely high quality of effluent produced by both the water and land-oriented technologies proposed is suitable for any potential water use, including water supply.

Costs:

	Water	Land	Total
Capital costs:	$49,091,000	$17,358,000	$64,449,000
Average annual cost:	$ 8,446,000	$ 2,048,000	$10,494,000

(operation and maintenance plus debt retirement)

3.6 Partially Centralized, Combination Water-Land System Quality Levels D and F[12]

Selection Criteria:

1. Offers economies in system design by allowing re-use of York's 2x effluent as P.H. Glatfelter's process water.
2. Eliminates the need for advanced (tertiary) treatment at York.
3. Integrates the needs and capabilities of the public and private sectors.
4. Requires unconventional legal and financing arrangements to adequately protect the several interests involved.
5. Dramatically increases stream flow in the West Branch below P.H. Glatfelter and through York City.
6. Contemplates the opening of Lake Marburg to body contact recreational activities.

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[12] This alternative was previously designated Va.

7. May allow the development of a permanent pool at Indian Rock Dam.
8. Realizes large economies at a high level of treatment otherwise much more costly.

<u>Design Criteria</u>:

Municipal and industrial flows projected to 2000 with no treatment contemplated for storm and agricultural runoff. Complete municipal water-oriented treatment is considered to include contact stabilization, clarification, nitrification-denitrification, 98% phosphorus removal, recarbonation, filtration, reaeration and chlorination. Municipal land-oriented treatment includes secondary biological treatment and tertiary renovation in the land. Treatment by Glatfelter would include adjustment of 2x influent for process requirements and full tertiary treatment for effluent including clarification, biological treatment, carbon adsorption, filtration, post aeration/cooling, and chlorination.

<u>Structural Components</u>:	IX, as in 3.5
Basic Treatment:	11 AS required: 7 existing, 4 proposed, 1 abandoned Existing facility at P.H. Glatfelter
Advanced Treatment:	2 T structures, one wholly new (P.H.G.), one an addition to an existing plant. 9 L sites with a minimum of one storage lagoon and well-field each.
Transmission:	3 major interceptors 3 short connectors Flow in all cases is $, save in 2x in line from York to P.H. Glatfelter
Solids Handling:	All plants are equipped with digesting and dewatering facilities which prepare sludges for application to the land.

Area Systems:

I. Greater York + Dover + New Salem + Hallam

Of 3 existing AS, the facility at Springettsbury receives a proposed T addition, the facility at York is enlarged, and the Dover AS is abandoned.

8-3/4 miles of transmission piping from Dover to York
2-1/4 miles of transmission piping from New Salem to York
12 miles of transmission piping (2x) from York to P. H. Glatfelter
1-1/4 miles of transmission piping from Hallam to Springettsbury
3 miles of transmission piping from York to Springettsbury
3 PS, one each at New Salem and Hallam, one midway between Dover and York

II-IV. As in 3.5

V. Spring Grove

1 existing AS
1 proposed irrigation site

P. H. Glatfelter: 1 enlarged input treatment plant
1 wholly new T effluent treatment plant

VI-XII. As in 3.5

Discussion:

This alternative utilizes water-oriented technologies to provide complete basic and advanced treatment at Springettsbury for a portion of the wastewater flows in the Greater York area. The major portion of that flow is given only 2x treatment at York and transmitted to P. H. Glatfelter for use as process water. In the remainder of the Basin, wastewater receives conventional secondary treatment and tertiary treatment by spray application to the land.

I. Greater York

R flows from Dover and New Salem are treated by the existing AS at York. The Springettsbury facility makes 2x + 98P effluent of R flow from Hallam and a .5 MGD flow from the York AS, discharging to the Cordorus at its present outfall site.

A 2x flow of some 23 MGD is transmitted to P. H. Glatfelter for re-use as process water.

II-IV. As in 3.5

V. Spring Grove

2x municipal flows are given 3x treatment in the land P. H. Glatfelter treats influent from York AS and then provides full tertiary treatment to level D for plant effluent. Discharge is to West Branch Codorus at present site.

VI-IX. As in 3.5

Outputs:

Quality of performance (mg/l) = 3x(D) or 3x(F)

D and F levels as in 3.5

Quantity (MGD), as in 3.5

Re-Uses:

A symbiotic relationship between York and P. H. Glatfelter is established as 2x effluent from the former becomes input water for the latter. The extremely high quality of effluents discharged to surface water throughout the basin allows a full-range of water uses.

Costs:

	Water	Land	Total
Capital costs:	$43,444,000	$17,190,000	$60,634,000
Average annual cost:	$ 7,386,000	$ 2,035,000	$ 9,421,000

(operation and maintenance plus debt retirement)

4.0 IMPACTS

4.1 Short-Term Impacts

Any project on the scale of the alternatives discussed here is likely to have major impacts on the relatively small economy of the Codorus Basin. Planning must therefore take into account not only the longer range effects of the various alternatives, but also the short-run disruption that will necessarily accompany the construction process.

A construction project in the range of $30 to $60 million would have considerable direct impacts on the economy of the Codorus Basin. Large amounts of money would be pumped into the area via (a) the acquisition of land needed for the project, (b) direct employment of local labor in the construction process, (c) the purchase of local materials for construction, and (d) the demand for goods and services by people inmigrating to work on construction and, later, those inmigrating to operate and maintain the system.

4.1.1 Land Acquisition

Land acquisition will be required by all of the alternatives for purposes of (a) plant sites, (b) transmission lines, (c) storage lagoons, and (d) land disposal of wastewater. Acreage estimates falling into the above four categories were estimated from the engineering data supplied by the Corps of Engineers.

Estimated Land Requirements

	Plant Acres	Pipe Miles	Lagoon Acres	Irrigation Acres
Alternative II, 1	110	10	-	-
Alternative II, 3	190	10	-	-
Alternative Ib, 7	160	25	-	-
Alternative IV	150	5	120	4000
Alternative V	90	12	120	4000
Current System	80	0	-	-

Cost estimates purely for land acquisition are assumed to be $750 an acre. However, in the estimates cited here the figures include the dollar value of structures which might be located on the land. Therefore, the average estimates rise to $2,000 per acre for plant land and $1,000 for land to be used for irrigation and transmission.

Land for transmission pipes, stated above in miles, is assumed to occupy a strip of land 20-30 feet wide, and when converted to acres for costing was estimated at five acres per mile of pipe. The following are the projected estimates of payment for land by alternatives:

Estimated Land Acquisition Costs, before 1980
(Plant = $2000/acre, Transmission and Irrigation = $1000/acre)

	Plants	Irrigation and Transmission	Total Cost for land
Alternative II, 1	30 acres	10 acres	$ 170,000
Alternative II, 3	110	10	$ 270,000
Alternative Ib, 7	80	25	$ 285,000
Alternative IV	70	4145	$4,285,000
Alternative V	10	4180	$4,200,000

It is likely that as much as 60-80% of this money would be pumped back into the local economy in the form of additional construction demand for displaced homes (particularly in the case of the land disposal alternatives) or as spending of windfall income.

4.1.2 Construction Phase Employment

Engineering estimates were unable to provide a ballpark figure for employment generated by the construction process. A rough estimate, based on national averages, is that about 30-50 people are employed by $1 million of construction contracts during a given year. Based on this very rough figure, we would expect the

construction generated employment for the various alternatives to be:

Estimated Employment in Construction before 1980
(Assumes 3-year spread of construction work)

	Plant and Transmission	Employment	
		Low	High
Alternative II, 1	$21.5 mill	200	350
Alternative II, 3	$26 mill (appr.)	250	400
Alternative Ib, 7	$41.6 mill	420	700
Alternative IV	$27.1 mill	260	450
Alternative V	$33.5 mill	280	480

Judging from the size of the existing construction industry in the basin, 150-250 people employed by the construction could come from the basin area itself. Moreover, a large number of farm operators would probably switch to construction work given the opportunity. Alternatives IV and V would create a simultaneous pressure to build new homes for families displaced by the land acquisition for the system which would absorb some, say 50-100 workers, from the available labor force for construction. The number of people involved in construction, although not terribly large in comparison with total employment of about 70,000 within the basin, would nevertheless constitute a visible work force.

4.1.3 Operating Labor Requirements

The wastewater management system will have direct employment requirements as well. The table below details estimates for overall employment by the several alternatives based on approximations made from data supplied by the Corps.

Pre-1980 Employment in the Systems

Current System	80
Alternative II, 1	105
Alternative II, 3	175
Alternative Ib, 7	110
Alternative IV	135
Alternative V	100

New employment generated by any of the alternatives is likely to fall below 100 additional workers. About half of these workers would have to have special skills in the maintenance and operation of sewage treatment plants and are not likely to be found in the region. Thus, while Alternatives II, 3 and IV are likely to have moderate positive impacts on the labor markets in the basin, the other alternatives would leave employment in the area largely unaffected.

4.1.4 Demand for Material

Construction would in addition place heavy demands on certain local industries: locally mixed cement, and other suppliers of the construction industry. A rough estimate (again based on national averages) is that some 10% of the construction contracts would fall to local suppliers, amounting to approximately $1 million of subcontracts annually if the construction work is phased over a period of three years. The magnitude of the effects is likely to be lower for higher treatment levels of water (i.e., Alternative IV) since these plants would use a higher percentage of prefabricated materials. We have been unable to obtain corresponding estimates for the size of the suppliers in the area, but it is safe to say that the relative impact will be quite large, and should receive further study.

4.1.5 Housing

The relocation aspects of large scale land acquisition required by the land disposal alternatives pose difficult problems for the area. There has been an increasing shortage of housing in the Codorus Basin area. Vacancy rates have dropped significantly during the past decade, both in the cities and in rural areas as indicated in the following table:

Renter and Homeowner Vacancy Rates
(Source: York County Planning Commission)

	1960	1960 Vacant	Vacancy Rate %	1970	1970 Vacant	Vacancy Rate %
County						
Total Owned	53,062	786	1.5	64,314	534	.8
Total Rented	20,405	946	4.6	23,779	756	3.2
City						
Total Owned	10,071	154	1.5	9,417	137	1.5
Total Rented	8,344	437	5.2	8,980	290	3.2
Balance of County						
Total Owned	42,991	632	1.5	54,897	397	.7
Total Rented	12,061	509	4.2	14,799	466	3.1

Accordingly, it should be difficult to find new homes for people displaced by the acquisition of land for wastewater disposal under Alternatives IV and V. An estimated 150-180 familes would be dislocated by the land disposal requirements of Alternatives IV and V according to engineering estimates, with most of these families presently occupying their own homes. In 1970, there were only 534 homes vacant in the whole of York County -- perhaps no more than 200-300 of these homes lying within the Basin area. The relocation of the 150-180 families displaced by the project cannot be achieved without simultaneous construction of new homes, and since most of the dislocated families would have to build rather than acquire older homes, compensation would have to be sufficient --

even if it is out of line with the value of the displaced property -- to allow families to buy new homes.

4.1.6 Public Services and Social Impacts

An inmigration of some 100-300 workers is likely to take place during the construction period. As stated earlier, a housing shortage does exist in the area, and it will be difficult to house the temporary work force. Another potential problem often associated with large projects of this sort is that the children of inmigrating workers overcrowd the schools of the area. However, this is not likely to be true in the Codorus Basin, since, except for exceptional boroughs, schools are generally operated at between 80-83% of their capacity.[1] Thus they should be able to handle additional school population without appreciable strain. This is likely to be true for other public services as well -- the loads put on hospital and public welfare services by a relatively healthy and well employed group are minimal. In short, despite significant expected inmigration, the impact on public services is likely to be small.

4.1.7 Commercial Activity

The additional workers and their families brought into the basin by the construction operation will slightly increase local commercial activity. Likewise, but to a lesser degree, those who are employed in maintaining and operating the system, will also demand goods and services. The factor most greatly affecting commercial activity, however, would be the increase during the construction phase in the absolute number of paying jobs. Inevitably, the previously unemployed or farm workers to whom the jobs go will increase their spending thus stimulating local commercial activity.

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[1] See Section 2.1, Sub-Area Profiles, Category D

4.1.8 Summary

As the preceding indicates, a sizeable amount of employment and income will be generated by the wastewater management systems studied here. Directly and indirectly, the installation of such a system would provide in the neighborhood of 500 jobs during the construction phase -- using a basin impact multiplier of 2 this amounts to an overall increase in employment of about 1000. This is a significantly large number -- amounting to over 1% of present employment in the basin.

When construction is completed and much of the impetus resulting from the investment is withdrawn, the expansionary effects of the project as detailed above will be reversed, and visible unemployment may well result. This effect can be viewed as a local equivalent of "disarmament" -- cutbacks in defense expenditures related to the Vietnam War also involved not much more than 1% of our national resources, yet the economic effects have been significant. Thus care must be taken that the proposed plan be phased in a manner that minimizes the aftereffects of the end of construction. The alternatives as presented all involve a controlled pacing of construction work and should with good management be likely to produce a relatively smooth return to normalcy.

4.2 Transitional Impacts

Troublesome though they are in terms of their ephemeral nature, short-term impacts on the social and economic structure of the Codorus watershed at least have the virtue of predictability. That is, there is a body of accumulated experience on large, intensive construction efforts and it is possible to forecast both desirable and undesirable changes well ahead of time.[2] And if to be forewarned is truly to be forearmed, it should also be possible to plan construction-related activities accordingly.

Less straightforward are middle-range changes: those that fall just beyond the planners' ability to predict and yet shy of that more comfortable "long-range" area where informed conjecture is respectable. Transitional impacts are second-generation phenomena that issue from the seemingly isolated changes generated early in implementation. They are exceedingly important because (a) they represent trends felt by virtually every basin resident--not just those immediately affected by construction, and (b) they are the propagators of third-generation impacts felt a decade or more later.

In the case of the Codorus, two transitional impacts have been selected for specific analysis: institutional relationships and recreation. In our opinion they are among the first and most important categories in which basin-wide changes will become perceptible.

[2] Given a single, precisely drawn plan, that is.

4.2.1 Institutional Relationships

Implementation of any of the alternatives discussed in Section 3.0 will have a large impact in this area because it is regional in scope and, by definition, will involve many different actors. State and local governments, regional authorities, Federal agencies, and a multitude of vested private interests will be affected. More practically, they must be cooperative, sharing a common water quality objective in order to make any system viable.

However, it appears that no single body presently has the range of powers and capabilities needed to build and then administer so ambitious a program. Local governments can allocate land for plant sites, but it is highly questionable whether they could bear even the usual percentage of cost for such expensive systems. The Federal government, through the Corps and the Environmental Protection Agency, could provide seed money in the substantial amounts required, but would not operate or maintain the treatment system once it became operative. Municipal sewerage authorities could provide such a service, but their powers would be limited by jurisdictional boundaries and insufficient for regional coordination. And so the roster goes.

Clearly, if a comprehensive wastewater management system is going to become a reality, the existing financial and administrative arrangements for water pollution control must be redesigned. To make even the most decentralized of the alternatives feasible, the roles and relationships of most of the present institutional actors will change. Generally, there are two ways in which that could happen. First, responsibilities for different administrative and operations tasks could be reapportioned among existing bodies. Alternatively, power could be centralized completely and vested in just one actor, old or entirely new. Though it lies outside the scope of this analysis to evaluate either approach, it is appropriate to point out that there are two instrumentalities that the citizens of the Codorus Basin should consider closely as possible administrative mechanisms.

(1) York County; an existing governmental structure which encompasses the whole of the Basin and could,

with an expansion of its mandate, collect the responsibilities for water management now fragmented among many municipalities. It should be recognized that the county form of government is extremely valuable because it can be responsive both to local needs and to the requirements imposed from above. The York County Planning Commission, for example, has been active in assembling a large data base in present conditions and articulating the policy objectives which seem best for County development.[3]

(2) Commonwealth of Pennsylvania, Regional Water and Wastes Management Authorities; bodies politic with broad powers to construct, operate, and maintain water supply and wastewater treatment works.[4] Passed by the House and still awaiting Senate action, the legislation pending would create such regional authorities through the state Sanitary Water Board. Given bonding powers, they could be of assistance to many small municipalities which are unable to finance the local share of construction costs. Even more comprehensive is proposed legislation for a State Water and Wastes Authority (previously House Bill 1695) which could -- once failure or refusal to comply with a pollution abatement order had been demonstrated-- itself construct the facilities required. In whatever form, an administrative body modeled on the Waste Acceptance Service in the State of Maryland could substantially simplify Federal, local, and private agency relationships and avoid at least some portion of the inevitable conflicts involved.

That there will be significant institutional changes is certain. Some will occur immediately (it is possible to proceed energetically without having a fully developed institutional plan), and most others will evolve in the time between construction start-up and completion of the system. All, however, should be negotiated in a spirit that will minimize bureaucratic antagonisms and keep the interests of a clean Codorus Creek uppermost.

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[3]For draft state legislation on strengthening county government, see County Reform, published by the Advisory Commission on Intergovernmental Relations, Washington, D.C., 1971. Especially relevant are "Voluntary Transfer of Functions Between Municipalities and Counties" and "County Performance of Urban Functions."

[4]The full text of the Authorities' description is here reproduced as it appears in House Bill 1696 of the 1969 session of the Pennsylvania General Assembly. The proposed legislation has since been renumbered.

Specifically, with regard to institutional arrangements, the alternatives are seen to behave as follows:

- II, 1 and 3--Since these schemes are most like the existing plans of the Commonwealth and highly decentralized, one would expect a minimum number of difficulties. The relationships between agency actors are well established and local officials are confutable with the construction grant program. However, the wisdom of heavy reliance on local initiative for compliance is questionable since a refusal by any one municipality would threaten the integrity of the entire regional plan. The level D quality required in Option 3 is likely to cause problems only insofar as its costs are higher and the financing more difficult.

- Ib, 1 and 7--This highly centralized system poses serious questions about jurisdictional barriers to cooperation. Unfortunately, compelling though the logic of regional integration may be, the probabilities of winning unanimous support are slight. Moreover, even if the majority of local interests were agreed on centralization, it is doubtful whether that concensus could be reached quickly.

  Once again, the issue of clean water could become lost in the welter of claims and counterclaims associated with cooperative ventures. The rights of way for long transmission lines required may be the subject of protracted legal proceedings. The abandoning of local plants already built or scheduled for construction will create the need for compensation mechanisms. Liabilities for system failure would have to be worked out, and so on.

- IV and Va--The use of land irrigation for upper basin effluent is an intriguing departure from convention. Since it represents a decentralized, town-by-town approach, at least from a political point of view it should not raise "home rule" arguments. On the other hand, the questions related to widespread relocations of population to make irrigation sites available will be many. Indemnification policies equitable toward both farm and non-farm residents will be required; policy decisions on ownership and conveyance of irrigation acreage must be settled, to name but two.

  Va raises some unique problems. If implemented as currently proposed, this alternative could place the tertiary treatment capability of the Greater York area in the hands of a privately owned and operated company. The symbiotic benefits to P.H. Glatfelter and York, just in terms of mutual cost-savings are impressive, true. But there does exist the possibility that Glatfelter's water needs will fall short of projected flows coming from York or, at the extreme, cease altogether as a result of the firm's failure. Carefully drawn legal language could insure an orderly municipal takeover, of course, but it is reasonable to assume that considerable additional public expense might be incurred.

From an institutional point of view the re-use contemplated in Va raises two important questions:

(1) the wisdom of tying the safe disposal of the Basin's major wastewater flow to the future of a private firm, and

(2) the expansion of Glatfelter's already considerable power base.

Private industry quite properly has interests sometimes different from those of the public. Therefore, great care should be taken to devise a legal framework whereby communities supplying process water to P.H. Glatfelter are not only not placed in a potentially compromising position, but adequately compensated.

In sum, regardless of the physical configuration of the regional scheme ultimately adopted, two issues will dominate the political scene: the surrender of vested power at every level of government and the allocation of cost-sharing burdens.

4.2.2 Leisure Opportunities

Recreational impacts[5] deserve special attention because they are the type of change associated with water quality improvement which is likely to affect the general population most directly and most quickly. In a sense, they represent quick "pay-offs" on the investment of public monies on pollution control and as such demonstrate that real benefits can be returned to those who share the cost.

Before specific technical alternatives can be evaluated for their respective contributions to public recreation, an understanding of the facilities and open space currently available in York County is required.[6]

[5]The term "recreation" here is taken to include both active and passive leisure-time activities. Active recreation might include water-related sports like fishing or swimming, while passive activities relate more to the aesthetic pleasures of picnicing, walking, or contemplation of natural scenery.

[6]The County was inventoried in 1966 by the Planning Commission and its findings updated in 1968.

- Neighborhood parks[7]

  In 1966 there were 121 neighborhood parks available to the County population. They ranged in size from 5.6 to 1/2 acre and had only play apparatus and open space as facilities. Only 1% and 2% offered ice skating and picnicing, respectively, indicating that in most cases passive recreational opportunities appealing to adults were almost completely absent. It has been projected that a total of 846 acres will be required for this type of park in 1985, some 280 acres to be acquired before that time to erase present deficits and provide additional capacity. Generally, urbanized and proximate suburban areas have the greatest unmet park need.

- District parks[8]

  Thirty-four district parks in the County totaled 584.4 acres at an average size of 17.2 acres. Though that figure is higher than the minimum standard, many individual parks--especially in and around high density areas--were considerably below standard. As in the case of neighborhood parks, adults would not be attracted to existing district parks; only 26% had tennis or basketball courts and 6% offered picnic areas. By 1985 a total of 291.5 acres should be acquired to meet projected needs.

- Urban parks[9]

  York County has two urban parks. Pigeon Hills is an 80-acre park north of Hanover and Memorial Park serves some 119 acres just

[7]Neighborhood recreation parks are generally associated with an elementary school and emphasize serving children and early adolescents. Usually the facilities available include play apparatus, playing fields, and open recreation areas. Desirable dimensional characteristics include: (1) 5 acre minimum size, (2) 75%/25% ratio of active to passive recreation area, (3) 1/2 mile from service population, and (4) 2.5 acres per 1000 persons.

[8]District parks usually adjoin junior and senior high schools and aim at serving the teen-age and adult population. Available facilities usually include playing fields and tennis or basketball courts. A district park should offer passive recreation opportunities--wooded lanes, benches, picnic areas--as well as open areas for football, baseball, track and field, etc. Desirable dimensional characteristics include: (1) 15 acre minimum size, (2) 50/50 ratio of active to passive activities, (3) 20 minute drive for those served, and (4) 2.5 acres per 1000 persons.

[9]Urban and extra-urban parks are recreational units intended to serve large numbers of people in every age group. In addition to open space such areas typically offer bridle parks, walking areas, swimming and boating facilities, and a zoo or natural area. Desirable dimensional characteristics include: (1) 100 acre minimum size, (2) 30 minute travel time from the urban center served, (3) 2.5 acres per 1000 persons. Extra-urban parks offer similar facilities but at a larger scale: 500 acres within one hour's travel time.

southeast of York. Though both areas are easily accessible open space, neither has well-developed facilities. Both have play apparatus, one a playfield and the other a skating rink. Neither offers tennis or basketball courts. Neither offers facilities for water-related sports such as swimming and boating. Neither has a zoo or nature study area.

Of the 235.6 acres required to meet 1985 needs for urban parks, 173.8 acres represent a deficiency existing in 1968. The area most urgently in need of a large park area is the northern portion of Greater York which at the time of the inventory had no public open space at all. The need is particularly acute because the rapid residential development of the York urban area has concentrated there. No extra-urban parks exist in York County, the projected need for 1985 being set at 2538.2 acres.

- Parklets

Often called "tot lots", these facilities cover less than a city block and serve between 300 and 700 neighborhood people ranging from infants to the elderly. The eight parklets in Hanover and York have play apparatus and some oversubscribed walking and sitting places for adults.

In total, the County had a deficiency of some 2470 recreation acres in 1968 which with an added 910 acres projected for 1985 makes a grand total of 3376 acres to be acquired for meeting future recreational needs.

But the shortage of acreage for recreation facilities is not so important as the relatively low quality of the recreational experience available to County residents. As they presently exist, neighborhood and district parks do not really offer much to adults. Associated chiefly with schools, they have neither the atmosphere, the appearance, nor the facilities which would appeal to mature users--few benches, paths, landscaping, etc. Urban parks are located at the western and eastern extremities of the basin and are more oriented toward week end outings than daily encounters with the natural environment. Most importantly, water activities--swimming, boating, fishing, etc.--are entirely unavailable at the local level.

The inescapable conclusion that leads from the discussion above is that the County looks to State and private facilities to provide the bulk of recreational opportunities to York Countians.

Five state recreation areas are located within York County. Three are state parks covering more than 5,640 acres, 1,615 acres of which are water. The Samuel S. Lewis Park located in East Central York County

has some 75 acres which offer views of the Susquehanna, picnic areas, and playfields. In the northwestern part of the County, Gifford Pinchot Park provides similar facilities but with the addition of a 340 acre lake with two swimming beaches and boating. The only in-basin recreational land administered by the state is Codorus Creek State Park in the upper West Branch. Still uncompleted, this area has 1275-acre Lake Marburg and boating and camping facilities.

Despite its lovely setting, though, the Lake is not available for water contact sports because P.H. Glatfelter Company owns management rights of up to 23 feet of drawdown. Thus, even if bathing would not interfere with the water quality requirements of the paper mill at Spring Grove, any beaches constructed at the public expense would be vulnerable to sizable drops in water levels controlled by a private interest.

Given the standard of 25 acres per 1000 population developed by the State, York County would require 6575 acres of State park land (1968 population figures). Without Codorus Creek Park this reflects a 65% deficiency in State park land. With the Codorus Creek Park there would be a 15% deficiency for 1968 population figures and a 33% deficiency for 1985 population projections.

Potential recreation sites

The York County Planning Commission has developed criteria for a County water-based recreation area. The area should:

(1) have at least a 50 acre pool with minimum existing development,

(2) be at least 10 miles from existing water-based recreation areas, excluding the Susquehanna River,

(3) be at least 5 miles from the County boundaries,

(4) be adjacent to at least 5,000 persons within 5 miles of the site.

The York County Water Supply Study and the Susquehanna River Basin Study both examined existing and potential impoundments for recreational development.[10] As a result there has been some sense of agreement about the desirability of more than a dozen reservoir sites in the southeastern part of the County. Four are of particular interest because they fall inside the Codorus Basin: one between Winterstown and Loganville Boroughs, two

[10]Naturally, water supply, flood control, flow augmentation were also treated in detail.

impoundments managed by the York Water Company, and Indian Rock Dam built as a flood protection project by the Army Corps of Engineers in 1942. In addition there is some measure of recreational potential in privately owned Pa Ha Ga Co in Spring Grove and the Hanover and Long Arm Creek Reservoirs which provide water supply for Hanover and its environs.

Conspicuously absent is Cororus Creek. Troubled by color problems and high organic loadings, three of the stream's four sub-basin headwaters are suitable only for the dilution and conveyance of municipal and industrial waste. A healthy aquatic environment and water suitable for body contact activities are either completely absent or largely inaccessible to the public.

Clearly, the regional wastewater management schemes presented by the Corps would raise water quality in the Codorus. Even at a low level of effluent quality (2x + 80P), measurable improvements in aesthetic value and selected game fish habitats would be possible. At a high level of quality achieved either by chemical or land application techniques the benefits multiply to include water supply, permanent water bodies, and a full range of water-related recreational activities--swimming, fishing, canoeing, streamside picnicing, etc.[11] Moreover, some alternatives address the problems of seasonal flow in the Codorus, local flow augmentation being another possibility opened up by a regional management approach.

Specifically, three potential areas for positive recreational impacts merit mention. First, the Codorus as it flows through York has possibilities for becoming a focal point of passive urban recreation. With high quality water at predictable flows, a complex of promenade, fountains and tastefully designed commercial space could well attract substantial numbers of urban dwellers. One of the principal complaints aired during the York

[11]One of the principal difficulties in performing an analysis of recreational impacts has been in relating varying levels of effluent quality to use. The assumption made is that full body contact is desirable only at the uppermost end of the quality scale, that is, in effluent treated to the limits of tertiary technology.

Charrette of 1970 was that the youth of the city and the elderly particularly had "no place to go". Certainly the redevelopment of the shabby industrial area bordering the stream should include the Codorus in plans to meet that clearly articulated need. Moreover, the stream below Springettsbury could, if managed carefully, provide the populations of the Greater York area with an accessible natural area where intimate contact with the water could be a daily pleasure in any season.

Both these urban core and extra-city potentials require further comment in an aesthetic impact analysis. But from the socioeconomic aspect, the realization of either one could produce impressive benefits for the most populous sector of the County. At a minimum, such a project would serve as a common goal around which splintered local interests could coalesce.[12]

A second major possibility for expanded water-related recreation exists at Indian Rock Dam. Should stream quality improve sufficiently (and at a high level of treatment by P.H. Glatfelter that is a safe assumption), it may be possible to maintain a permanent pool. Engineering data has not yet provided a definitive statement on the technical feasibility of such a plan, but the central location and large size of the acreage involved makes detailed investigations of the dam's structural capabilities worthwhile.

Finally, and perhaps most immediate is the possibility of opening Lake Marburg to full public use by providing P.H. Glatfelter with an alternative supply of intake water. Already programmed as a recreation-focused impoundment, the Lake could become the major water sport resource of the Codorus Basin, all this contingent on designing trade-offs attractive to P.H. Glatfelter.

Alternatives II and Ib at a low level of quality fail to produce the dramatic improvements in water-related recreation that such sizable costs would lead taxpayers to expect. At a high level of quality, whether by a

[12]The York Charrette emphasized the clear split between suburban and in-city thinking on annexation and/or consolidation of York and its medium-density satellite communities. By providing services available nowhere else, downtown York could in some measure reestablish its legitimacy as an economic pacesetter and make formal consolidation more attractive.

decentralized or centralized configuration of plants, the benefits returned more directly meet the principal recreation need of the Basin--namely, water contact opportunities.

Alternatives IV and Va appear particularly promising in two respects. First, they both incorporate land irrigation which, by preserving open space from undesirable urban encroachment, provides a "natural area" buffer zone between urban areas. Although it is unclear to what extent they would be used, lagoons for the treatment and storage of effluent could become permanent water bodies with varied recreational potential.[13] Further, because irrigation would not be carried on during the winter months, wooded and cleared irrigation sites alike could be opened to cross-country skiers, though in all fairness to the safety of the irrigation system public access would have to be carefully controlled. Second, both concentrate relatively large volumes of clean water, at single points, and thus increase the reuse potentials for effluent over those in the decentralized system in Alternative II. In this respect, however, Alternative Va has distinct advantages over IV because that concentration occurs well up in the basin at P.H. Glatfelter, giving downstream communities a second pass at both its quantity and high quality.

[13] The Santee Project could serve as an instructive case study for this kind of possible impact. Located in California, this installation uses a series of high to low elevation ponds coupled with sand filtration to treat wastewaters.

4.3 Long Term Impacts

4.3.1 Land Use Impacts

The general trend in the basin is toward infill growth in the urban nodes and semi-urban nodes, with moderate population increases outside these areas. The Red Lion, Yoe, Dallastown nodes of Triboro seem to be developing into a large population center which will eventually merge with York. Hanover and Penn Township in the southwestern corner of the region have seen sizable population increases. The Shrewsbury-Railroad-New Freedom area in the south-eastern part of the basin is also rapidly becoming more urban. Suburban population pressure has also brought about a slow suburbanization in the central part of the basin, in the semi-urban nodes of Seven Valleys, Jacobus, Loganville, and Jefferson.

As a result of the population increase described above, and because of adverse conditions effecting agricultural profitability, the general trend in the region has been toward greater residential, and reduced agricultural use for land. Land in farms has dropped from a County total of about 550,000 acres in 1910 to about 360,000 acres in 1970, with a further projected decline to 260,000 acres in 1990. These statistics would show an even more substantial decline for areas within the basin, since most of the urban and semi-urban developments have taken place around the periphery of York and the urban areas cited above along the two major highways intersecting at York, Routes 83 and 30.

As the basin becomes increasing suburban and urban, a rational land use plan will become extremely important. Green belt areas will have to be set aside to preserve the aesthetic appeal of the basin, as well as to provide the proper balance between vegetation and human populations to protect air quality.

The location of industry is an important determinant in this respect. In line with the arguments set forth in Section 4.3.4, the following may be said about the likely land use impacts of the alternatives:

Alternative II (whether option 1 or 3) will tend to encourage industrial locations in much the existing pattern. Assuming that population growth would follow the pattern of industrial location, we might expect relatively dense population around the urban nodes of York-Springettsbury, Red Lion-Yoe-Dallastown, Hanover-Penn Township, and Glen Rock-Shrewsbury-Railroad-New Freedom.

These areas are likely to be surrounded by rings of lower density suburban residential areas. Green areas would be left chiefly in the west-central portions of the basin.

Alternative Ib will tend to centralize industry in the northern portions of the basin surrounding York. The remaining green belts are likely to run across the basin with primary portions in the west-central area.

Alternative IV would (a) tend to centralize industry in the northern portions, and (b) physically set aside large areas for purposes of land irrigation. The resulting areas would partly satisfy greenbelt functions (that is they would exclude land from industrial or residential use) but would not be directly equivalent to areas left in natural form either in terms of aesthetic appeal, or in terms of vegetative balance. Other methods of irrigation (i. e., forest spraying or overland flow) are more suited for greenbelt preservation, through they are impractical for the basin since there is a general shortage of forest acreage with proper conditions to permit wastewater disposal.

Green belt areas from Alternative IV would include most of the areas cited under Alternative Ib and in addition certain areas northward around the New Salem semi-urban node. The alternative would have the undesirable side effect of further increasing the population density of the Greater York area.

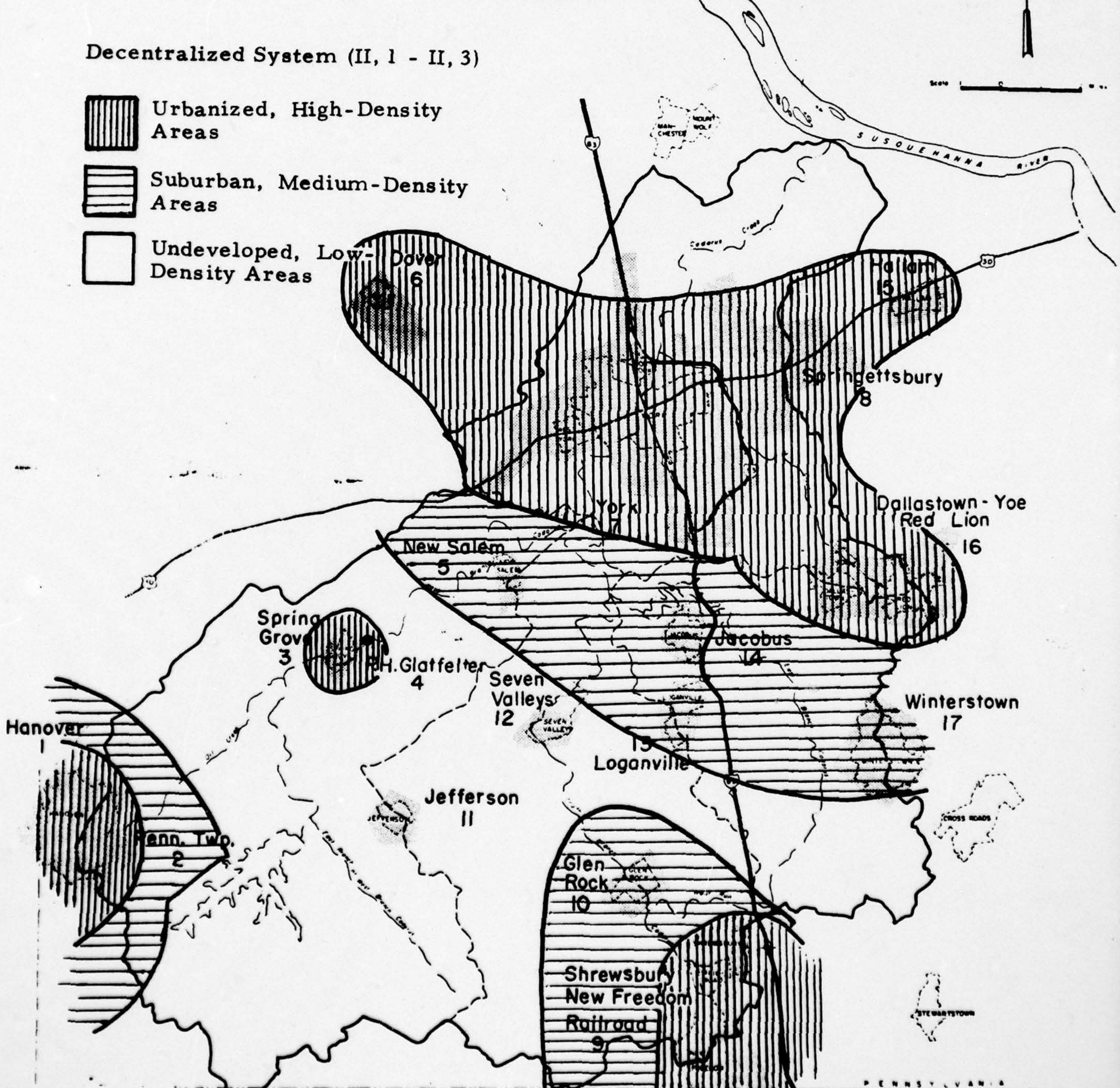
Alternative V differs from Alternative IV in one important respect: the guaranteed water supply for P. H. Glatfelter might allow a fuller recreational use for the Lake Marnburg area. The basic green belt areas would thus remain unchanged, except that in

an important instance their use to the public would be significantly enhanced. The detailed aspects of this change are described in Section 4.2.2.

CODORUS CREEK BASIN

Regional Development Patterns

2000 A.D.



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CODORUS CREEK BASIN

Regional Development Patterns
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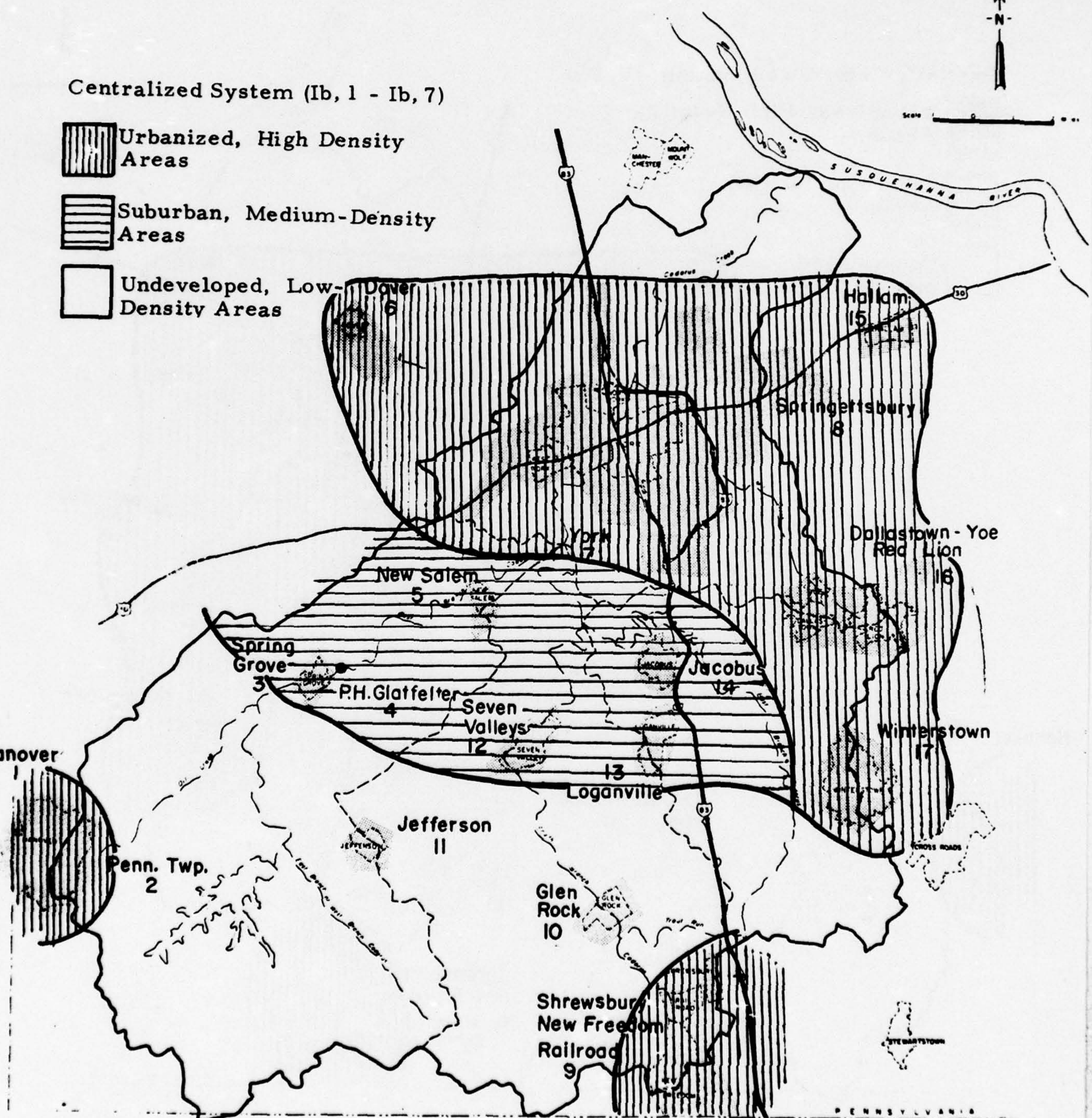
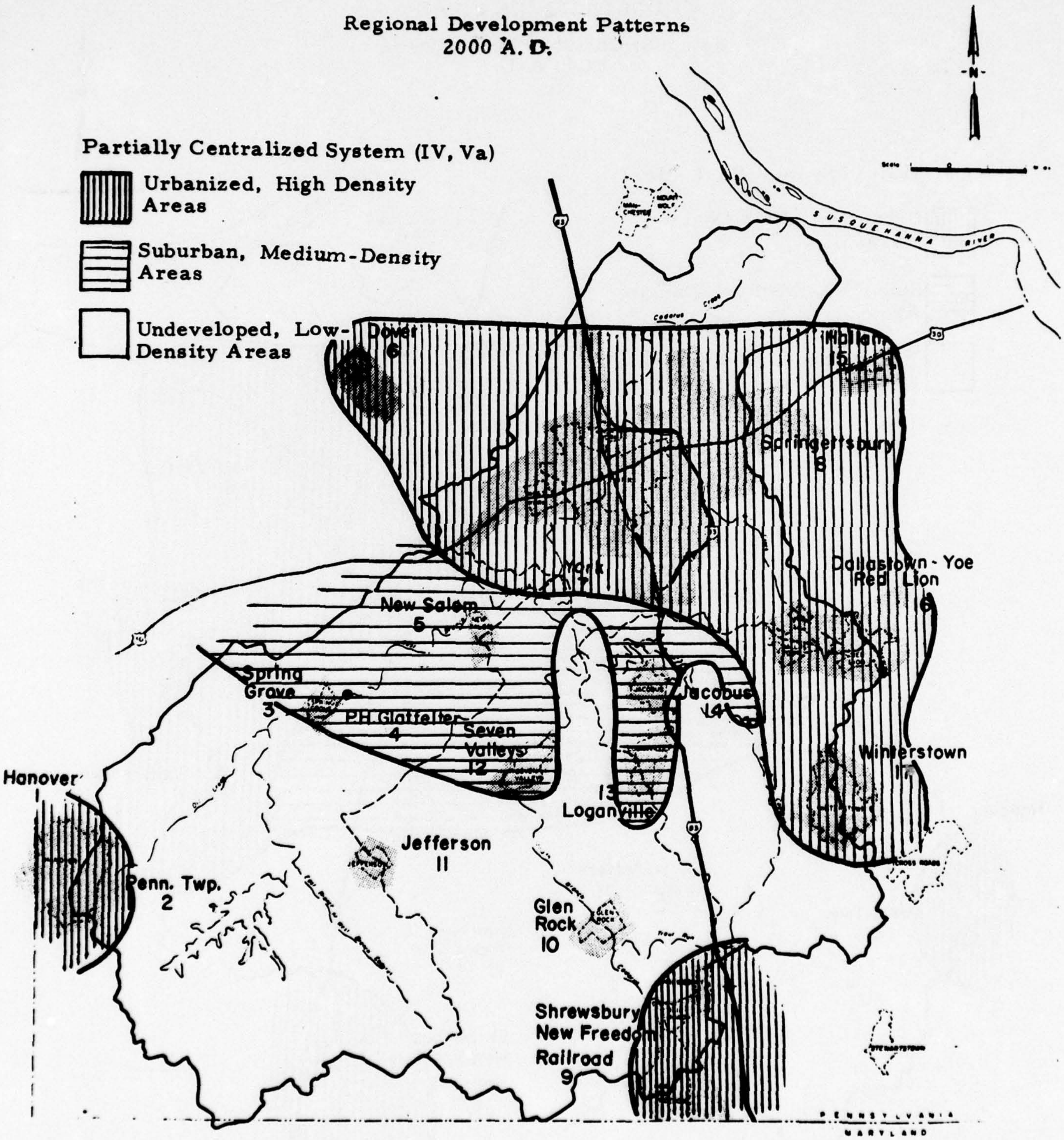


CODORUS CREEK BASIN

Regional Development Patterns
2000 A. D.

Partially Centralized System (IV, Va)

- Urbanized, High Density Areas
- Suburban, Medium-Density Areas
- Undeveloped, Low-Density Areas



4.3.2 Changes in Land Value

Land value changes are usual by-products of large construction undertakings. Land acquisition will be required by all of the alternatives for (a) plant sites, (b) transmission lines, (c) storage lagoons, and (d) land disposal of wastewater. Acreage estimates falling into the above four categories were previously presented in Section 4.1.2.

Land adjoining the acquired land will experience fluctuations in value. The altered value of the land will depend on the current use of the adjoining land area and the use (i.e., whether plant, lagoon, or irrigation) to which the acquired land will be put. In particular:

- If the land acquired is scheduled for plant construction or expansion, and if a sewage treatment plant already exists in the area, neighboring lands are not likely to experience serious fluctuations in price. A sewage treatment plant fits fairly comfortably into a general industrial zone. The sites that the author examined (including the most important York site) are already industrial in character, and sufficient open land seems to be available to effect expansion. The same appears to be true for smaller existing plants.

- If the land acquired is scheduled for plant construction and no sewage treatment plant exists on the site (for example, in the Jacobus, Loganville, Jefferson and Seven Valleys area) the land neighboring the sewage treatment plant site will probably become unsuitable for residential use, an effect not unlike the one that would be caused by reasonably large new industrial plant. Surrounding land values may increase slightly if the site is properly chosen--i.e., avoids major residential areas.

- Transmission lines are not likely to bring about any changes in the value of land separated by a few hundred feet on either side. In the immediate zone surrounding the pipes, the expectation of possible disruption (due to pipe failures) may depress land values, especially for land used for residential purposes. Since homes as well as industrial establishments tend to be located close to roads, this consideration suggests that transmission lines be placed at a distance of a few hundred feet from the roads, provided that the additional expense thus incurred is within tolerable limits.

- Land used for lagoons is likely to depress surrounding land values significantly, as a result of both its essential unattractiveness, and possible odors. This may be the most significant among the land value impacts. Lagoons should be located near treatment plants for most efficient operation, and should not detract from urban settings. Without careful design, neighboring land could become undesirable for residential and, to some extent, even industrial uses.

- Land used for irrigation purposes may either increase or decrease the desirability of neighboring land and hence its market value. From a residential viewpoint, the expectation (even if unjustified) that odors would result from the irrigated area would tend to make neighboring land less desirable. Since land irrigation areas will be away from main transportation arteries, it is unlikely that the surrounding land area would have significant industrial desirability. The opposite argument could be made, however, based on the assumption that land irrigated areas can be viewed as permanently preserved green belts. However, given the nature of irrigation planned for the area -- mobile rigs spraying on cleared land -- the preserved open space will not have the aesthetic appeal of natural landscape.

4.3.3 Agricultural Implications of Land Treatment

The renovation of wastewater by land irrigation offers direct benefits from the use of water as an irrigant and the beneficial side effect of providing natural fertilizers as plant nutrients. However, if the fertilizer-irrigation value of wastewater is to be realized, there must be sufficient large scale farming in the area to take advantage of the disposal system.

The agriculture industry has faced a severe decline in all of York County, and especially in the more densely populated areas encompassed by the Codorus Basin. The magnitude of the decline is exhibited in the Tables below.

Agricultural Tables

(1) Distribution of Farms by Output, 1964

Value of Sales	% of Farms
<$5000	59.5%
5000 - 10,000	14.5%
10,000-20,000	14.0%
>20,000	12.0%

Source: Economic Analysis, Volume I, Y. C. P. Commission

(2) Farm Operators Working Off the Farm (1964): 55%

(3)

Acres in Farms	York County	Basin Estimate
1950	450,000	N. A.
1960	410,000	N. A.
1970	370,000	122,000

(4)

Value of Farm Products
York County, 1964

	Value ($1,000)		Percent of Total	
All crops sold		11,540		33
Field crops	7,145		21	
Vegetables	1,260		3	
Fruits & nuts	1,608		5	
Forest and horticultural				
Specialty products	1,527		4	
All livestock and livestock products		23,216		67
Poultry and poultry products	8,400		24	
Dairy products	7,955		23	
Other livestock and livestock products	6,861		20	
Total	34,756	34,756	100	100

Source: 1964 United States Census of Agriculture

Existing farming tends to be on a small scale, and, as indicated by statistics for the off-farm work of farm operators, does not provide a large enough income for those engaged in it. Farming tends to be used as a supplementary source of income to non-farm employment in the basin area.

The reasons for this decline are many -- and quite general to almost all farming areas on the fringes of the high density, industrial Northeastern seaboard of the United States.

First, the land in the area is subject to heavy competition from urban-related uses. This includes highways, suburban developments, and recreational and vacation home demands from the urban areas. Accordingly, the land values in the area are considerably higher than in other parts of the country, placing farming here at a competitive disadvantage.

Second, conditions of climate and terrain are less advantageous than in the Midwest. Most of the countryside consists of rolling hilly land, making the use of large scale equipment impossible. Farms have tended to be small in size, partly due to historical patterns associated with the early settlement of Southeastern Pennsylvania. This further limits the use of large scale farming technology and prevents the realization of real economies of scale.

Third, modern transportation technology has made the Midwest and other producing areas directly competitive with older Northeastern farms. Economies of scale realized by farms in other parts of the country cannot any longer be offset by the proximity of local farms to northern markets.

Fourth, the availability of higher paying jobs in the urban areas has lured young people into the cities. To the extent that they still operate family farms, they do so to supplement their income, as argued earlier. This is particularly true for the Codorus Basin where York provides a close job market.

Against this backdrop it is difficult to imagine a resurgence of the agriculture industry needed to make optimal use of the wastewater irrigation offered by the land disposal alternatives. Crops particularly well suited for land irrigation (corn, hay, and other feed crops) are the most tenuous in the basin. Fruit and vegetable farming may survive provided that enough labor saving devices are adopted to make production profitable even in the face of relatively high labor costs and land values. But intensive farming is not well adapted to land irrigation: fruits and vegetables eaten raw, for example, may be unable to profit from the application of secondary treated effluent because of possible public health dangers from high

coliform counts in an irrigant. Dairy farms on the other hand may benefit from irrigation, but the effect of coliform levels in effluent irrigated on pasture land has not been established with respect to the safety of the herds.

In a previous study of irrigation with effluent, we computed the rough annual value of effluent used as an irrigant (including its fertilizer value) at about $22,000 per MGD.* It is quite likely that no more than 10-20% of this value will be in fact economically useful, resulting in rough cost savings of $40,000 per annum for the land disposal aspect of the system.

There are inherent difficulties in using effluent irrigated lands for agricultural purposes. The technology of the equipment planned for the area would tend to favor use of the land for pasture, but (as argued earlier) the safety aspects of the use of high-coliform content effluent need further study. In addition, the legal aspects of the system would need to be worked out: for example, if the land is abandoned as pasture, whose responsibility is it to keep the land cleared?

Further study is needed to determine whether the pasture use of such lands is feasible. Efforts should be made to discuss the problem with large local dairy producers to ascertain interest on part of the farming community. Acceptance of effluent irrigation

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*A study by Pennsylvania State University; Sopper, "Effects of Trees and Forests in Neutralizing Waste" puts the fertilizer content of typical municipal sewage effluent at 1,500 lb. of 12-9-10 fertilizers per acre when the effluent is applied at the rate of 1" per week per acre during the summer months. The purchase cost of 12-9-10 is in the neighborhood of $35 per ton, consequently 2" per week would cost about $50 per acre if purchased directly. Irrigation systems also cost about $50 per acre assuming a reasonably accessible water table. These two savings, when multiplied by about 220 acres needed to dispose of 1 MGD, amount to about $22,000 per MGD. Altogether, 12 MGD will be disposed in the Southern sections of the basin, yielding a total possible saving of $264,000 per annum. But not all of the effluent will be needed (i.e., it would not be bought at this price if offered), hence real savings are likely to be only a fraction of that total.

should pose no serious problems -- the farming community has been long accustomed to using human waste (more recently in the form of sludge) as a fertilizer.

As for the specific alternatives, the present discussion applies equally to Alternatives IV and V, and not to any of the others. The analysis yields a tentative conclusion that dairy production (as against the baseline) could benefit from well planned application of wastewater on land.

4.3.4 Regional Economic Development

Improvements of wastewater management in the Codorus Basin implied by Alternative II, Option 1 will have several indirect, though possibly significant, impacts on the economic development of the basin area. Above all, the region will become a better place to live, and hence serve as a more favorable location for new industry and business. An increasing consciousness of environmental quality implies that people will prefer to live in places where at least some of the environmental problems have been solved; this in turn implies that firms locating in the basin will have a relative advantage in attracting manpower. The extent of this impact is not measurable at present -- data will begin to develop only as experience from several projects like the one under study accumulates.

Moreover, there are more direct factors which favor industrial location in an area with regional wastewater treatment facilities. Every new firm which produces wastewater in significant quantities faces a difficult decision-making process in choosing a location. If the area does not have appropriate wastewater management, chances are that such a system will have to be instituted at some time. The costs of such a system are not knowable to the firm at the time of location. Becoming a polluter is politically risky if not plainly illegal, and economies of scale in wastewater treatment imply that it will normally cost a firm more to install its own treatment facilities than it would to hook up to an existing system.

This element of risk is eliminated if the area in question already provides a coherent system of treatment facilities. The additional cost of locating in such an area (i.e., higher taxes required to support the system) are most likely outweighed by (a) the reduction in uncertainty about the future, (b) savings in treatment cost due to economies of scale in treatment, and (c) a favorable sharing of the cost burden; the system may be partly paid for already, may have received considerable federal aid, etc. These effects cannot be estimated concretely without specific case work focused on a particular type of industry and a single technical alternative. Nevertheless, in a qualitative sense, it is quite clear that regional water quality and wastewater management quality is becoming an increasingly important factor in industrial location and that the Codorus Basin stands to gain by proceeding quickly toward a comprehensive system.

The other side of the development coin is that the system devised has to be able to accommodate industrial development. The problems that arise for a new firm in a polluted area that does not have adequate wastewater management are magnified in the context of an area with generally high quality water but an inflexible treatment system. The industry would either have to (a) face payment for a costly expansion of the existing facilities, or (b) build at even higher cost a private treatment facility which measures up to local standards. Should the firm choose to go its own way, it is forever subject to the risks of polluting an "otherwise unspoiled" area.

The above is not an argument for overengineering or building huge excess capacities into a wastewater management system. It is instead an argument for system planning that allows for low-cost flexibility to suit the needs of a series of unknowable future development patterns in the region. In assigning system capacities to various points in the basin, each alternative automatically places costs on industrial location. As a result, each alternative will tend to impress its own stamp on the development prospects of various areas within the basin. For example, all of the land disposal alter-

natives for the southern part of the basin imply serious inflexibilities with regard to potential development in that area. If, say a company producing a 0. 5 MGD were to locate in a mid-basin town, land to provide tertieary treatment would have to be acquired and equipped on a rather large scale: the acquisition of some 300 acres would be necessary (counting both lagoon and irrigation area) in addition to possible expansion of the local secondary treatment facility. Moreover, depending on the nature of the industry, output might be better treated in other ways; land disposal is best suited to treat the organic loads of wastewater and not the potentially hazardous constituents of industrial flows.

In the following analysis, we seek to detail the developmental implications of various alternatives. We distinguish here between only three sets of alternatives, since options within each set provide the same degree of capacity and differ only in process sequence. As to the relative merits of centralized over decentralized systems, the question comes down to the costs of expanding the carrying capacity of the collection network compared to the costs of expanding a local facility. One would imagine that there is some break-even point with respect to distance; at some distance from the central plant, the marginal cost of expanding a local wastewater treatment facility becomes lower than the cost of adding pipelines to transmit the added waste to a central plant. It has not been possible to determine from the data provided in the engineering cost estimates the exact distance at which the break even point in the Codorus occurs. Nevertheless, it appears likely that the southern-most areas of the basin would retain a more flexible posture toward development with a decentralized treatment system.

The baseline (Alternative II, Option 1) system would probably be biased slightly in favor of development in areas served by relatively large facilities. In these areas the projected industrial growth rate is meaningful enough to provide for sufficient leeway to accommodate new firms. The projected growth rate for industry in presently undeveloped areas of the region is less meaningful, and

some of these areas may experience quite significant changes in capacity demand should the areas attract new industry. More simply, the same "random shock" will have a greater relative effect on smaller treatment systems. Accordingly, we would expect that the baseline alternative would tend to keep industry away from the central parts of the basin, and serve as an impetus for industrial location in the northeast and southwest basin; the York, Red Lion, and Hanover urban nodes.

The centralized system (Alternative Ib, Option 1) would tend to favor the northern areas of the basin over the southern areas in terms of future industrial location because of the relatively lower cost of expanding transmission lines closer to the central facility located in York. When compared with the baseline, this alternative would probably have no new effects on the Greater York area, but would tend to improve the industrial prospects of the Red Lion area, New Salem, and the smaller semi-urban nodes in the center of the basin. This alternative is likely to discriminate against development in the southerly urban nodes; Hanover and Penn Township, and in the emerging Shrewsbury complex of towns.

The land alternatives (Alternatives IV and Va) would provide equivalent capacities throughout the region, and are indistinguishable from the viewpoint of flexibility. As argued earlier, the high costs of acquiring new land -- should it even be available -- tertiary treatment in the southern reaches of the basin would tend to limit treatment capacity to the levels incorporated into the plans themselves. Where water-oriented technologies are used (in the York area), we would expect alternatives IV and Va to have impacts no different from the baseline.

4.4 Summary

From the viewpoint of regional economic development, all of the alternatives attract new industry to the basin by:

(1) improving the aesthetic environment and increasing recreational opportunities which would in turn aid new industry in attracting manpower;

(2) removing some of the uncertainty about industrial responsibilities for water treatment;

(3) providing lower cost waste treatment.

When evaluated from the viewpoint of flexibility to encompass diverse and possibly unforeseeable development possibilities:

(1) Alternatives II, 1 and II, 3 offer roughly equivalent advantages, slightly favoring already established areas for future industrial location;

(2) Alternative Ib, 1 tends to favor industrial location in the northern parts of the basin relative to the southern portions;

(3) Alternatives IV and V tend to discourage industrial development beyond levels in the initial design for the southern parts of the basin.

5.0 IMPACT SUMMARIES

5.1 Decentralized, Water-oriented System (II, 1)

- Generates numerous independent treatment plants, maximizing quality control and system coordination problems
- Minimizes transmission costs but produces many separate plant construction disruptions
- Introduces an additional flow from Dover which would otherwise go to the Conewago Basin; flow reductions in the Conewago require examination
- Achieves improvements in water quality enhancing aesthetic, habitat, and non-contact recreational values
- Contemplates abandoning a treatment system at Dover presently in the final planning stages
- Fails to recognize the Mill Creek Interceptor Plan which would obviate the need for a treatment at Triboro
- P.H. Glatfelter wastes are dramatically improved with respect to COD, BOD, SS, and color
- Will tend to encourage industrial locations in the northeast and southwest basin, encouraging population growth in York-Springettsbury, Red Lion-Yoe-Dallastown, Hanover-Penn Township, and Glen Rock-Shrewsbury-Railroad-New Freedom
- Would leave greenbelt areas in chiefly the west central areas of the basin
- Will increase the attractiveness of the basin to industry by making the basin a desirable place to live, and by insuring an inexpensive, certain, and perhaps partially paid for treatment system
- Favors development in areas served by relatively large facilities where the projected industrial growth rate is meaningful enough to provide for sufficient leeway to accommodate new firms
- Requires the least land acquisition and consequently involves the lowest land acquisition costs
- Would offer the fewest employment opportunities, both in the construction and operations phase

5.2 Decentralized, Water-oriented System (II, 3)

- Provides a dramatically higher level of treatment consistent with a healthier ecosystem and recreational uses expanded to include full body contact

- Requires increased acreage to accommodate additional unit processes but causes no substantially greater surface disruptions or relocations

- Requires roughly twice the staff per 1 MGD plant for operation and maintenance. At this level of quality an on-site effluent monitoring laboratory with a full-time chemist would be required, staffing and job descriptions varying by plant capacity

- Imposes no requirements upon P. H. Glatfelter not already included in the Commonwealth's implementation plan or alternative II, 1 at a lower level of treatment. The responsibility for improved plant performance falls entirely on municipal systems, where the bulk of associated benefits appear to fall

- Would slightly favor already established areas for industrial location, as would alternative II, 1

- Leaves green belt in the west-central portions of the basin

5.3 Centralized, Water-oriented System (Ib, 1)

- Creates an on-going operations phase labor demand at a central location

- Requires substantially greater acreage in the Greater York urban node to accommodate facilities with 1980 flows of 28 MGD and 10 MGD at York and Springettsbury, respectively, and a combined flow of 38 MGD

- Requires basin-wide surface disruptions for the construction of transmission systems

- Without appropriate land-use controls, increases the dangers of uncontrolled suburban sprawl along transmission lines

- Abandons all existing and proposed local treatment plants with a subsequent total loss of existing investments

- Increases opportunities for regional cooperation in programmed development

- Distributes costs more homogeneously throughout the basin, though the financing mechanisms ultimately selected will determine how equitably

- Re-establishes the primacy of York as the purveyor of a se service unavailable elsewhere in the Basin; associated shifts in public attitudes toward the county seat as a focus of power.

- Slightly reduces flows at points C and E[1] and increases the wastewater portion of main stem flow above York.

- Reduces flows in Oil Creek and Plum Creek tributary of the Conewago.

- Concentrates a large volume of water at York but fails to return it above the city to augment local flow.

- Simplifies future advances in quality of effluent by requiring changes only at the York tertiary plant.

- Allows future decentralization to provide treatment for increases in quantities of flow as they occur in local jurisdictions.

- Increases the dangers of system failure by providing only one municipal tertiary treatment capability for the Basin.

- Tends to favor industrial development in the northern areas of the basin because of the relatively lower cost of expanding transmission lines closer to the central facility located in York.

- Improves the industrial prospects of the Red Lion area, New Salem and the smaller semi-urban nodes in the center of the Basin.

- Leaves green belt areas chiefly in the west-central portions of the Basin.

- Offers the greatest number of employment opportunities during the construction phase.

- Requires moderate land acquisition and commensurate costs.

5.4 Centralized, Water-oriented System (Ib, 7)

- Concentrates large volumes of super-clean water at York but fails to utilize its potential for York by discharging below the city.

- Creates a demand for roughly 1 1/3 the staff required by the same system at level B quality.

- Area requirements increase by some 60 acres over B level for D level quality.

- Does not alter 60 MGD/80 MGD ratio of plant effluent to stream flow in the main stem below York, but improves water quality so substantially that any detrimental effects perceived are inconsequential.

- Improves recreational potential for the "white water" portion of the stream in terms of visual enjoyment and riparian activities. However, though effluent could support full body contact the physical configuration of the stream prevents extensive beach development.

- Centralization increases the potential damages resulting from system failure since higher quality will generate a larger roster of high-order water reuses.

- Represents a cost-savings over Alternative II, 3 which produces the same level of quality in effluent but through a decentralized system.

- Tends to encourage the centralization of industry in the northern parts of the basin, surrounding York.

- Would most likely result in green belt areas running across the basin with primary portions in the west central area.

5.5 Partially Centralized, Combination Water-Land System (IV)

- De-emphasizes importance of York area as a crucial system component.

- Relies on local initiative for quality control.

- Opens possibilities for fish spawning and related game management through storage lagoons and irrigation sites.

- Fuller quality control through well-field recapture systems possible.

- Offers greater flexibility for future re-use options by affording complete control of land-irrigated effluent.

- Fails to achieve economies of scale possible with physical integration of urban nodes and proximate semi-urban places.

- Requires the dislocation of many families, many not in rural, agricultural contexts.

- Brings presently unregulated sludge application practices and cannery effluent spraying under strict control.

- Centralizes industry in the northern portions and sets aside large areas for purposes of land irrigation, which would only partially satisfy green belt functions

- Locates primary green belt areas in west central area, as in Alternative Ib, and in addition, in certain areas northward around New Salem

- May inhibit future industrial development due to the relative inappropriateness of land disposal at levels of intensive use for the potentially hazardous constituents of industrial waste water

- Will most likely result in the reduced value of the land surrounding the lagoons, which may become undesirable for residential and, to some extent, even industrial uses

- Will result in the relocation of many people in an area where housing is scarce, due to the large tracts of land necessary for lagoons and irrigation

5.6 <u>Partially Centralized, Combination Water-Land System</u> (Va)

- Increases the power base of P.H. Glatfelter; tertiary treatment capability for Greater York (less Springettsbury) dependent on continued industrial operation

- Flows through York and in the West Branch significantly increased; recreation and aesthetic potentials enhanced in areas now utterly deficient

- Return of benefits to Basin principally in the form of full public access to Lake Marburg

- Localizes significant construction impacts at Spring Grove; both a wholly new intake treatment plant to prepare process water and a tertiary facility to renovate plant effluent before discharge to stream

- May give water-poor residents of the Greater York area access to a permanent pool at Indian Rock Dam without compromising the flood protection it affords to downstream property

- Might allow a fuller recreational use for the Lake Marburg area

- The basic green belt area, which would be the same as Alternative IV, would be in the west central area and northward around the New Salem semi-urban node

- Tends to centralize industry in the northern portion of the basin

- Implies serious inflexibilities for potential economic development with regard to the magnitude of waste treatment necessary; large tracts of land would need to be acquired and equipped for treatment of any large new quantity of industrial waste.

- Involves substantially higher land acquisition costs, due to large tracts necessary for lagoon and irrigation

- Implies decreases in the value of the land located around the lagoon area due to the unattractiveness and possibly the odor of the area

- Implies reduced desirability of the land neighboring irrigation land for residential purposes

- Might involve serious housing relocation problems due to the large area of land which would be required and the general housing shortage in the area

CHAPTER III

VISUAL IMPACT STUDY

1.0 INTRODUCTION

This visual impact study is divided into two sections; the first section deals with the visual impact of the wastewater management components on the existing landscape and direct visual results (hydraulic flaws and water quality); the second section deals with the visual impact of probable development and land use activities resulting from the wastewater management program.

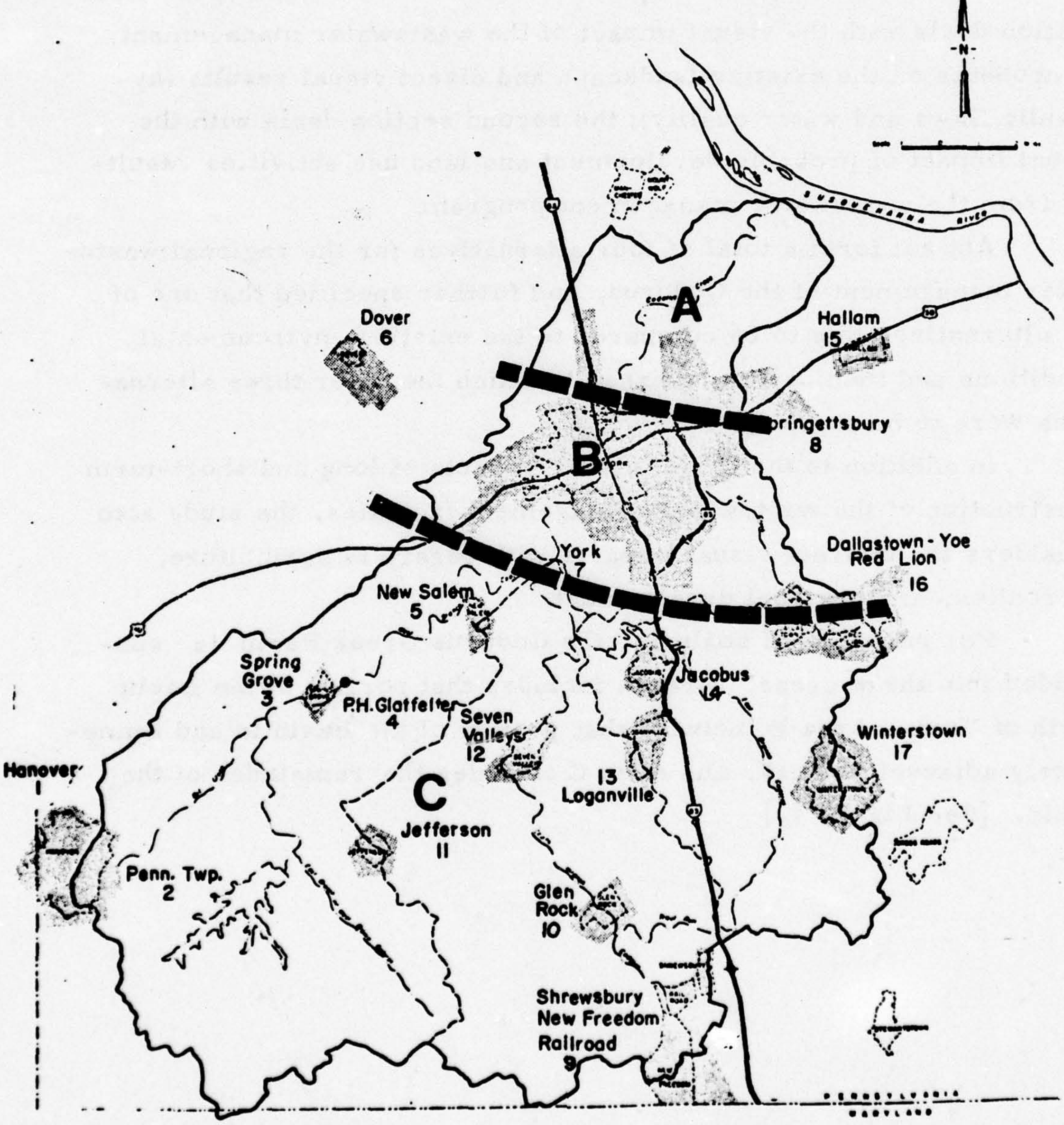
Abt set forth a total of four alternatives for the regional wastewater management of the Codorus, and further specified that one of the alternatives was to be compared to the existing environmental conditions and then used as a base, to which the other three alternatives were to be compared.

In addition to the direct visual impacts of long and short-term construction of the wastewater management facilities, the study also considers the indirect visual impacts with regard to agriculture, recreation, and regional development.

For purposes of analysis, the Codorus Creek Basin is subdivided into three areas. Area A includes that portion of the Basin north of York. Area B includes that portion of the Basin in and immediately adjacent to York, and Area C includes the remainder of the Basin. [See Figure 1.]

Figure 1.

CODORUS CREEK BASIN SUB-AREAS



2.0 VISUAL ANALYSIS OF THE CODORUS CREEK BASIN

The triangular Codorus Creek Basin, roughly 250 square miles in size, is contained totally within York County in the Commonwealth of Pennsylvania. Agrarian land use activity largely accounts for the environmental character of the landscape within the basin boundaries. In addition, the urban and semi-urban centers, together with the resultant suburbanization, significantly contribute to the visual image.

The most important physiographic element of the Basin which contributes to the visual image is topography. The visual diversity of the Basin is a result of the predominately open, gently undulating hills, accentuated on occasion by steep ravines and rock outcroppings. Currently, the Codorus plays a relatively small visual role in the landscape, with only a few expanses of water visually accessible from primary observation zones. The vegetation that has not been cleared accentuates the steep topography and visually contains the highly scenic pasture and cropland pattern.

2.1 SUB-AREA A

Sub-area A is marked by the most gently rolling topography of the Basin, and because of this, the Codorus takes on an increasingly important visual role. Because of the road system, which is entirely secondary in nature in the immediate vicinity of the Codorus, the Creek is not visually accessible from the automobile. The road system here, as in most cases within the Basin, crosses the Creek at right angles and seldom parallels it for any significant distance. Mainly because of this, one is largely unaware of Codorus Creek. More importantly, however, because of the relationship between the circulation system and the Creek, the Codorus has for the most part remained untouched by human settlement. The Creek in this sub-area, therefore, offers great potential as a natural link between the City of York and the Susquehanna River.

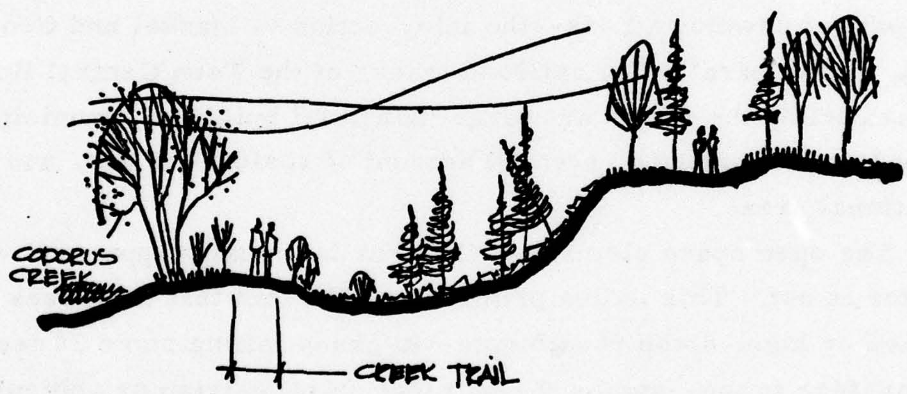
Figure 2.

USE DETAIL

Sub-Area A

Figure 3.

CROSS-SECTION



Sub-Area A

2.2 SUB-AREA B

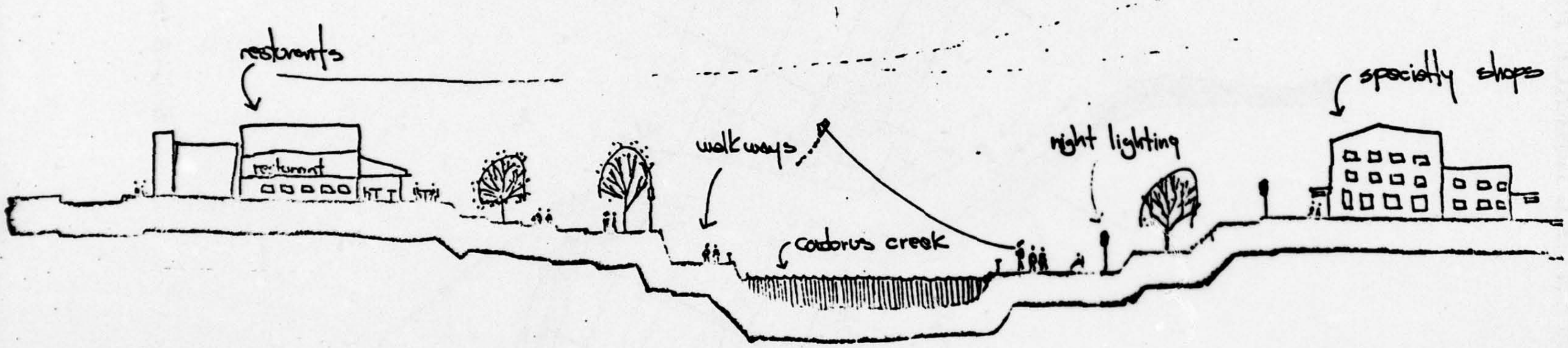
Within Sub-area B, the Codorus is virtually a visual non-entity. As is typical in most American cities and town, York has historically turned its back on the water element which penetrates the center of the city. The Creek's sole function has been to carry away human and industrial waste and only as a secondary and unplanned function, to provide open space within the heart of downtown York. The downtown section of York is losing its commercial and visual vitality to outlying shopping centers. Many people that I had occasion to speak with commented that York was becoming a ghost town; they could only in a limited way see the beneficial potential of the "Stinky Codorus."

The Creek itself is located only two blocks from the most active part of downtown York--the intersection of Market and George Streets, and is paralled by railroad tracks of the Penn Central line. Also paralleling the Creek are large industrial buildings, municipal parking lots, vacant land, a small amount of residential use, and recreational areas.

The open space element of Codorus is visually apparent, while the water is not. This is due primarily to the fact that the Creek is contained by high, steep revetments--in cases falling some 20 feet below surface grade--and by the fact that no pedestrian or vehicular circulation system immediately parallels the Creek. The actual treatment of the banks ranges from natural shapes to concrete embankments. The current use of small concrete walls in conjunction with rock shapes is visually acceptable, as is the use of natural shapes.

Figure 4.

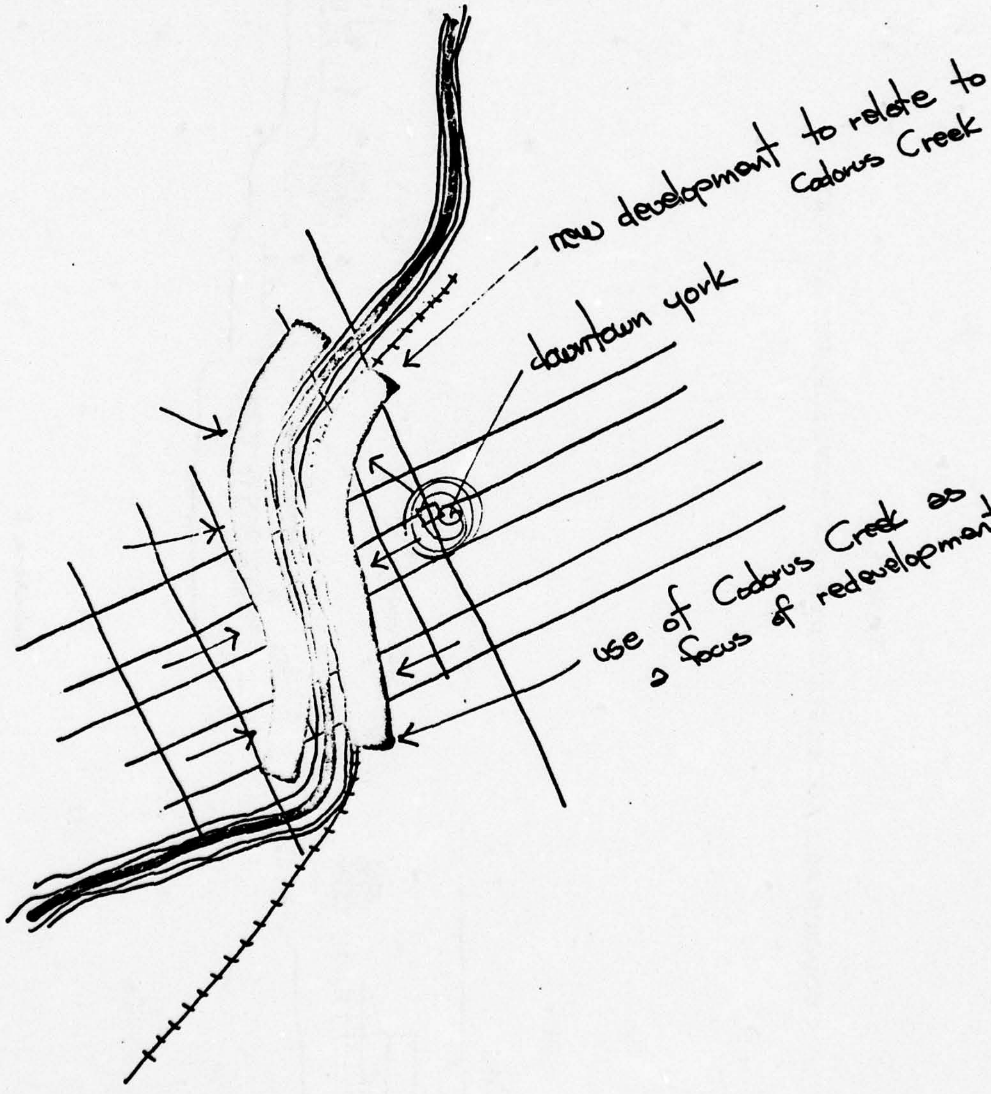
CODORUS AS A FOCAL POINT OF URBAN DEVELOPMENT AT YORK



Sub-Area B

Figure 5.

POTENTIAL LINKAGE PATTERNS AT YORK



Sub-Area B

2.3 SUB-AREA C

Sub-area C of the Codorus Basin has many of the visual attributes mentioned in Sub-areas A and B, but on a minor scale. Again the Creek is a visual non-entity even in the rural landscape, because of the general lack of visual and physical access from the road system and because of the poor visual relationship between the Creek and the small towns through which it runs. The most visually significant element that the Codorus contributes to the landscape in this sub-area is large and open expanses of impounded water. York Reservoir, north of the Borough of Jacobus and visually prominent from Interstate 83, greatly adds to the visual diversity of the landscape in that area. Because of the suitable topographical configuration, the general physiology of this sub-area and its close proximity to York and other areas of concentrated urbanization, Codorus Creek in Sub-area C has the potential of providing an increased amount of positive visual diversity and areas of water-oriented recreational activity.

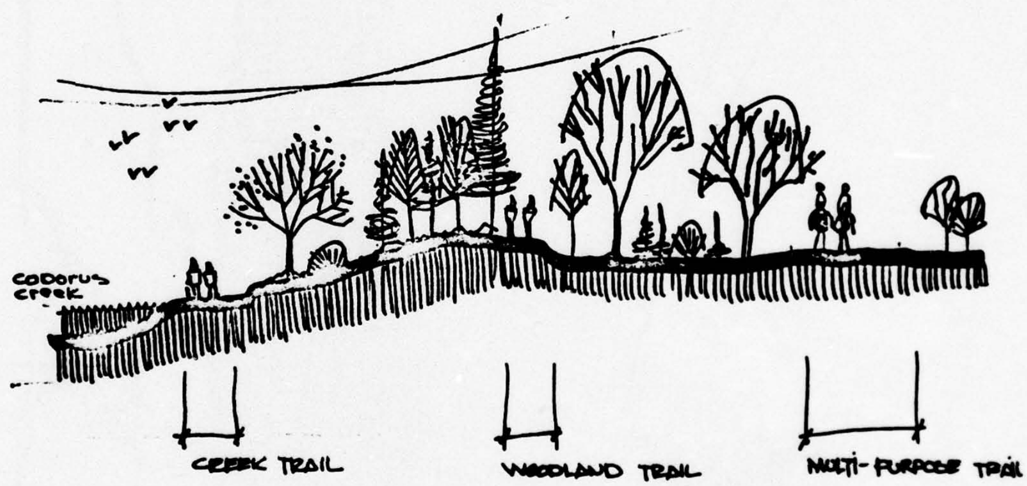
More so than the other two sub-areas, Sub-area C is marked with the visual annoyances of scattered residential development on the open hills and ridges of the Codorus Creek Basin. These developments greatly detract from the otherwise scenic and pastoral landscape. In addition to insensitive residential development, industrial complexes also have caused visual degradation of this landscape character. Location, scale, and architectural refinement have largely been ignored in the planning of these complexes and, as a result, they become a visual blight on the landscape.

Existing wastewater treatment facilities in each of the three sub-areas also contribute somewhat to a negative visual impact. These water disposal facilities take on the scale of a small industrial complex--large, low-profile buildings and buried tankage. Actual location of the treatment facility in relationship to main entries and exits of a municipality and primary observation zones from major highways or important buildings are perhaps the most critical elements. Although in most instances, the existing treatment facilities do contri-

bute to a negative visual impact, it is nearly insignificant in comparison to suburban sprawl and major industrial complexes

Figure 6.

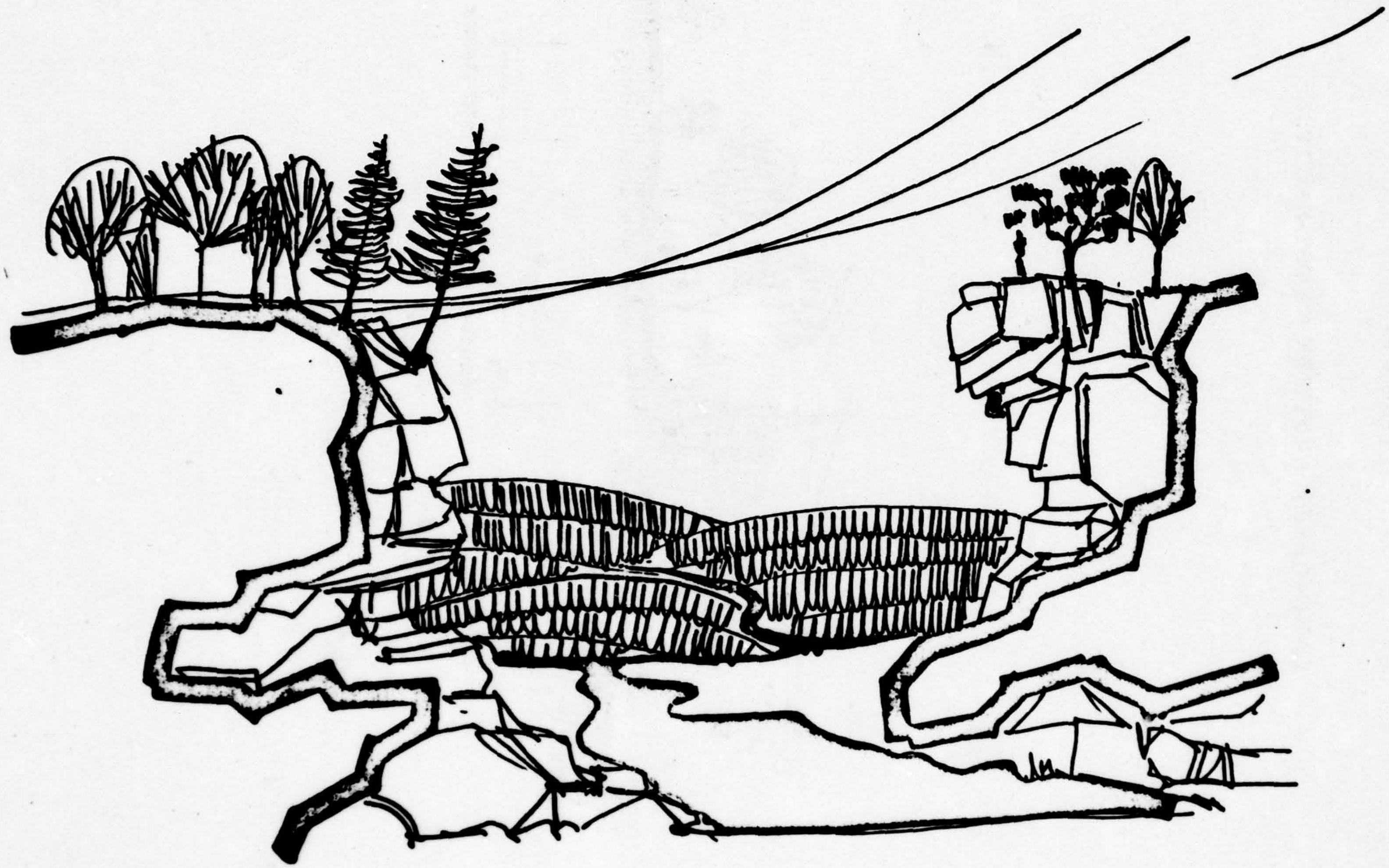
LAND-BASED ACTIVITY CROSS-SECTION



Sub-Area C

Figure 7.

DETAIL



Sub-Area C

Figure 8.

WATER-RELATED ACTIVITY CROSS-SECTION

Sub-Area C

3.0 REGIONAL WASTEWATER MANAGEMENT - FOUR ALTERNATIVES

The four alternative proposals for regional wastewater management in the Codorus Creek Basin are as follows:

Ib - - A totally centralized regional facility for treatment of municipal wastes which discharge to Codorus Creek below York. Optional levels of treatment include Treatment Class B and D. In this alternative the wastes of the P.H. Glatfelter Paper Company are provided with advanced waste treatment for color removal and discharged to Codorus Creek above Indian Rock Dam. Configuration and treatment options encompass Municipal Treatment Classes B and D.

II - - A decentralized system for treatment at existing or presently programmed local treatment facilities with discharge to the Codorus Creek at these localized locations. Optional levels of treatment include Treatment Classes B and D.

IV - - A partially centralized system which includes secondary conventional treatment and land irrigation of the upstream municipal wastes, and Class C treatment of York and Springettsbury service area wastes with discharge into Codorus Creek; Glatfelter wastes are provided with advanced waste treatment for color removal and discharged into the West Branch. Optional levels of treatment include Treatment Classes D and F.

Va - - A system which includes the same physical configuration of plants as in IV but includes the reuse of York secondary effluent as process water for the P.H. Glatfelter Company; advanced water process treatment of P.H. Glatfelter process wastes and advanced water process treatment of Springettsbury service area wastes with discharge to the Codorus.

Abt has specified that a comparison between present conditions and alternative II be made first at Treatment Class B and then at Treatment Class D. The assumption was made that D is suitable for any reuse including full body contact and that B is suitable for boating, fishing, and general aesthetic appeal.

The approach is then to compare alternative II with the remaining three alternatives (Ib, IV, Va).

The visual impact comparisons are made considering the two main factors: (1) The direct visual ramifications of the treatment facility components and resultant water flow and quality and (2) The indirect visual ramifications of improved Creek conditions.

The distinct visual impact differences between land disposal systems and water disposal systems are of paramount importance in assessing the direct visual ramifications of the various alternatives.

Visually, land disposal systems affect large land areas, are basically not responsive to variations in the landscape, and demand large scale land manipulations. In some cases multiple use of land is possible, i.e., forest timber growth, agricultural crop production. The system is not flexible in terms of location because of the need for natural storage areas as well as large areas of suitable soil types. The visual impacts of land disposal components are generally negative because of scale and landscape alternative.

Water disposal techniques affect relatively small areas and are visually equivalent to a large industry. Location is usually the most critical factor in incorporating the facilities into the existing landscape character. Water treatment facilities are flexible in terms of size, expansion, physical composition, and in their relationship to existing waste treatment plants. Small scale combined with great flexibility enables water disposal facilities to be appropriately integrated into the existing environmental character thus producing insignificant amounts of negative visual impact.

3.1 EXISTING CONDITIONS/ALTERNATIVE II

The most significant negative visual impact resulting from the implementation of Alternative II is the increased size of the various local treatment facilities. At three of the critical points where present flows were measured and projected, the minimum average monthly flows in Mgd were from 24 to 29. Flows at other points were measured at 6, 45, and 75. The implementation of Alternative II would increase the flows at each of the six points and would thus add to the visual quality of the Codorus. However, with an increase in flow, the average for treatment plants also increases - though not significantly. The most significant factor causing increased acreages for treatment plants is the type of treatment level. For example, at a flow of 40 Mgd secondary treatment requires 90 acres, and Class D treatment requires 150 acres.

At the 30 Mgd flow level Alternative II Class B treatment would require an additional 20 acres for the necessary treatment facilities. This is a substantial increase in size, but by and large, the various existing local sites could adequately absorb that increase. Already existing treatment plants at a set location - the treatment plant is already part of the environmental character for a particular area - and other proximate development has taken that factor into account.

Class D treatment would require an additional 60 acres for necessary facilities, an increase which would definitely have a visual impact on the area. Since the location is already established, however, the negative visual impact could be mitigated by using low profile components, appropriate site planning, and compatible architectural detailing.

Besides the augmentation of stream flow, Alternative II would, of course, improve the water quality in the basin to some degree. Improved water quality itself has a direct visual impact of a positive nature - cleaner water. Yet, the use of Codorus Creek water for recreational activities and visual pleasure must be carefully analyzed for there are both positive and negative visual impacts which could result.

A Codorus Creek of high water quality (Level D) has the potential of: structuring regional development, providing open space usable for recreation and public enjoyment, and initiating the redevelopment of central urban areas which would be oriented toward passive use and visual enjoyment of clean water. With the addition of clean and usable water in the Codorus Creek Basin, the general public and planning officials should take a second look at the role of existing agricultural land. Clean water in the Codorus would undoubtedly further promote the development of this land for residential use.

Since land of this type visually complements the Codorus corridor and adds to the visual diversity of the region, action should be taken to insure the preservation and accentuation of the present landscape character. Development that recognizes the integrity of the agrarian

landscape and is sensitively planned and located should be encouraged. If visually inappropriate development is allowed to take place, the overall positive visual impact of a usable stream and subsequent reservoirs will be greatly reduced.

Improved water conditions in the Codorus Basin would improve the recreational potential of the Creek itself, as well as adjacent lands. High water quality would tend to promote the preservation and restoration of natural areas which abut the Creek and its borders. Through public and official support the Codorus offers the potential of linear multiuse corridors. Pathways adjacent to the Creek could be developed for nature walks, bridle paths, and cross-country skiing. Wilderness camping areas primarily accessible by canal and picnic areas in close proximity to urban areas and road systems, could also be developed. Also within Sub-area C the use of existing improvements for recreational acitivities could be intensified and, in addition, new high quality water areas could be developed - specifically the Indian Rock Dam area.

Within Sub-area B a high quality Codorus Creek could provide the initiative for progressive urban redevelopment in the City of York. Instead of turning its back on the Creek, appropriate development could focus attention on the Codorus which could serve as a unifying link and activity generator in the presently decaying York urban environment. The Creek and its attendent development could help reverse the out-migration trend of York and create a viable and visually exciting downtown area. The Creek could be the focus of open spaces, commercial enterprises such as specialty shops, outdoor cafes, restaurants, convenience shopping, and entertainment. Fountains and integrated water improvement areas could be developed which would increase the visual and psychological awareness of the Codorus. Of prime importance is the redirection of pedestrian movement to and along the Creek. People must be able to come close to, and even enter the water.

The open space element of the Codorus could be reinforced by the addition of plant material and night lighting. Night lighting and late night cafes would help create an active and safe nighttime urban environment. Appropriate night lighting could also enhance and accentuate the nighttime visual qualities of running and impounded water. The intro-

duction of these elements into the Creek could create exciting visual events. In addition, the man-made waterfalls would produce water sounds and smells that would be refreshing to the urban dweller.

The Codorus in Sub-area A offers the greatest potential for day hiking, picnicking and canoeing. Within a short distance from York the Creek presents extremely scenic and picturesque landscape. Here the Codorus could provide a natural retreat from urban life. The greatest attribute is the relatively abrupt change from an urban to a natural landscape. This attribute should be preserved and reinforced, thus providing for greater visual diversity and uniqueness of experiences.

These are the highlights of the direct positive visual impacts and indirect benefits that a clean and usable waterway could foster.

The point should be strongly made, however, that those benefits accrue to the people of York County in direct proportion to the level of water quality achieved in the Creek; the cleaner the water, the greater the return on the taxpayer's investment in treatment systems. Since the positive impacts and benefits are essentially the same for each of the alternatives, only the significant resultant differences need to be discussed in the comparisons between Alternative II and Alternatives Ib, IV and Va.

3.2 ALTERNATIVE II/ALTERNATIVE Ib

Alternative Ib is a totally centralized regional facility which does not significantly differ from Alternative II with respect to the visual implications of flows. However, there are significant visual impact differences with respect to the compoents of the facility itself, i.e., the introduction of major transmission facilities into the landscape. Depending on the exact location and alignment of the transmission lines either major or minor negative visual impacts could result. Improper placement of the line would degrade the visual environment of the region by cutting through existing stands of negation. Careful attention must be paid to zones of primary observation, abrupt topographic changes and areas of a shallow depth to bedrock.

If proper location and alignment play an important role in the placement of the line it could possibly serve in a multi-use capacity. However, the use of a transmission line corridor for hiking trails, etc., has serious drawbacks. The line would be located with priority

on efficiency and least cost criteria and will not necessarily follow or connect areas of high scenic value, thus limiting the transmission corridor as a nature walkway if the line is properly integrated into the landscape character, the facility need have little negative visual impact. In comparison to Alternative II, however, this alternative presents a greater potential threat to the visual quality of the area.

3.3 ALTERNATIVE II/ALTERNATIVE IV

Alternative IV is a partially centralized system which does not significantly differ from Alternative II with respect to the visual implications of stream flow. There are, however, some slight differences in flow which favor IV over II, except in the York and Mill Creek areas.

The greatest difference in visual impact between Alternatives II and IV is due to the land disposal component of Alternative IV. Because of the large acrages required for land irrigation of the upstream municipal wastes and the nature of the acrage itself, this component of Alternative IV represents a potentially serious encroachment on the existing visual quality of the Codorus Basin. The Basin is a small one and depending on the ultimate physical appearance of irrigation rigs and retrieved wellfields, land disposal could become an intrusion difficult to conceal. In a sense, of course, irrigation fields would preserve the openness of the landscape. Ultimately, though, accessibility of the acreage is the immediate measure of public benefit. Were winter access a possibility, and the physical structures on an irrigation site, the land system could be seriously considered as a possibility. Without such assurances, the negative visual impacts associated with Alternative II seem safer, if only because they are known.

3.4 ALTERNATIVE II/ALTERNATIVE Va

Alternative Va includes the same physical configuration of plants as in IV and this poses similar visual threats to the landscape. In addition, a long transmission line is also called for. The negative visual impacts of transmission line corridors has already been discussed in

reference to Alternative Ib. The combination of the undesirable visual impacts of both the land disposal component and the transmission line component of Alternative Va, could significantly reduce visual quality in the Codorus Creek B sin unless sensitive design work were a top priority of the project.

Alternative Va creates a larger flow in the West Branch below Glatfelter and in that portion of the Codorus that penetrates York, than does Alternative II; for those reasons it compares favorably with the baseline condition. However, Va also creates lower flows in the Codorus above Spring Grove. From an aesthetic point of view, a smaller volume of water in the West Branch headwaters - precisely the area where the natural character of the stream has been least improved - is unfortunate if not plainly destructive.

4.0 SUMMARY

In general, all four alternative systems appear to complement the General Land Use Plan established by the York County Planning Commission. Their attention to regional solutions for what too often are construed as local problems is uniformly commendable.

However, while the indirect visual benefits related to high water quality in the Basin appear to be equal for all the alternative systems contemplated, the direct visual impacts of the treatment facilities themselves could be significantly different. The large physical structures inherent in the centralized system, Ib, could seriously impair the urban environment at York and the areas immediately adjacent to the long transmission lines required for collection. Alternatives Iv and Va, on the other hand, because they require intensive management of large tracts of land pose serious threats to the rural landscape. In either case the ultimate effect will be a function of the care with which construction proceeds and the stringency of the design controls imposed. Without more precise information on the design of specific physical structures, this analysis concludes that Alternative II is preferable if only because it mitigates the undesireable effects of conventional "system building" by dispersal and diffusion.

On the issue of water quality, it would appear that the potential enhancement of the quality of life in the Codorus Basin is far greater at high levels of water cleanliness. For example, if the stream is indeed to become a focus for urban development, it would be a foolish economy to invest in any but the most advanced water treatment equipment. Though the higher cost might seem a deterrent, it is a legitimate opportunity cost for realizing potentials otherwise impossible.

While the indirect visual benefits appear to be equal for each of the four alternatives, waste water management systems, the direct visual impacts of the treatment facilities themselves could be significantly different. Without more precise design criteria for specific physical structures the decentralized system proposed by Alternative II appears

the least destructive of visual quality in the landscape. With regard to these variances Alternative II - a totally decentralized system - is favored.

The indirect visual results, which are potentially more dramatic than the water treatment facilities in each of the flow alternatives, tend to complement the General Land Use Plan as established by the York Country Planning Commission.

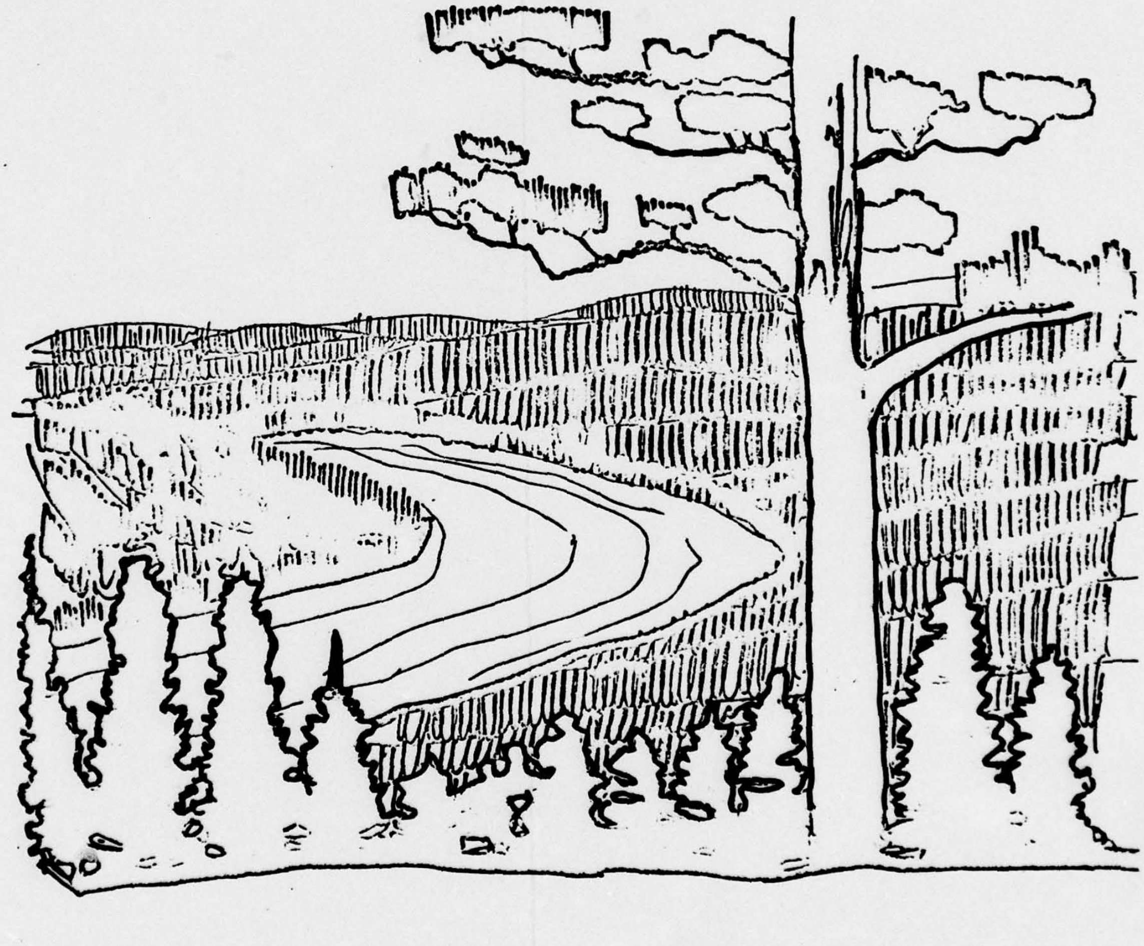
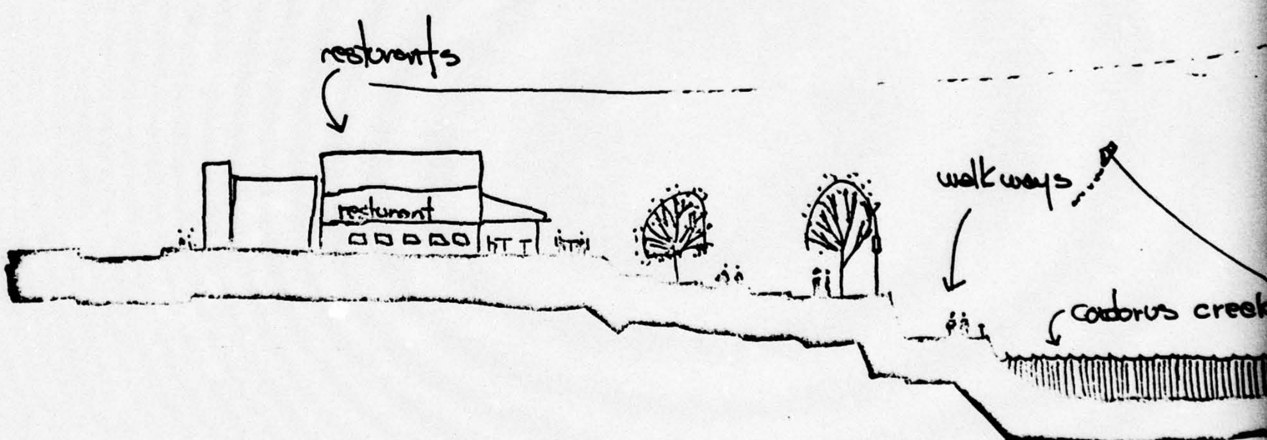


Figure 4.

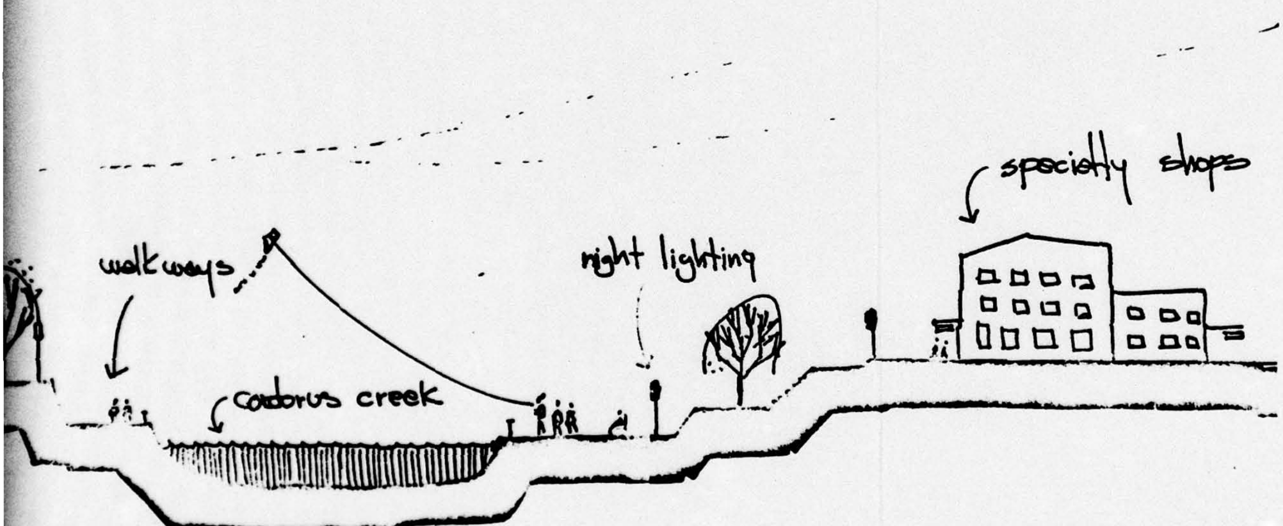
CODORUS AS A FOCAL POINT OF URBAN DEVE



Sub-Area B

Figure 4.

AL POINT OF URBAN DEVELOPMENT AT YORK



Sub-Area B

CHAPTER IV

AQUATIC ECOLOGY IMPACT STUDY

I. Aquatic Biology of Codorus Basin

The aquatic community of the Codorus Creek and its tributaries can be described as a warm-water ecology. The present polluted condition of the water has dramatically altered the aquatic community to the point where few characteristics of a healthy warm-water ecology are evidenced.

Under less polluted conditions one would expect to find a diversified biota characterized by a variety of green plants, benthic invertebrates representing insect families such as Ephemeroptera (Mayflies), Trichoptera (Caddis flies), and Odonata (Dragonflies) and Megaloptera (Alderflies). The community would be dominated by fishes such as largemouth and small mouth bass (Micropteras) and sunfish (Lepomis). These fish would be the basis for a sport fishery.

Little evidence of biological eutrophication is present in most of the basin observed by the consultants, or is to be found in the single report on biological conditions prepared by the Pennsylvania Department of Health and the Pennsylvania Fish Commission. In general, organic and inorganic pollution loads throughout most of the stream coupled with high turbidity are sufficient to mask or eliminate typical eutrophication effects derived from aquatic plant product activity. The only area of high plant growth noted was just above the confluence of the East Branch of Codorus Creek with the South Branch. In this area the stream fans out into almost a marsh-like condition where a high degree of emergent aquatic vegetation would be above expected and normal.

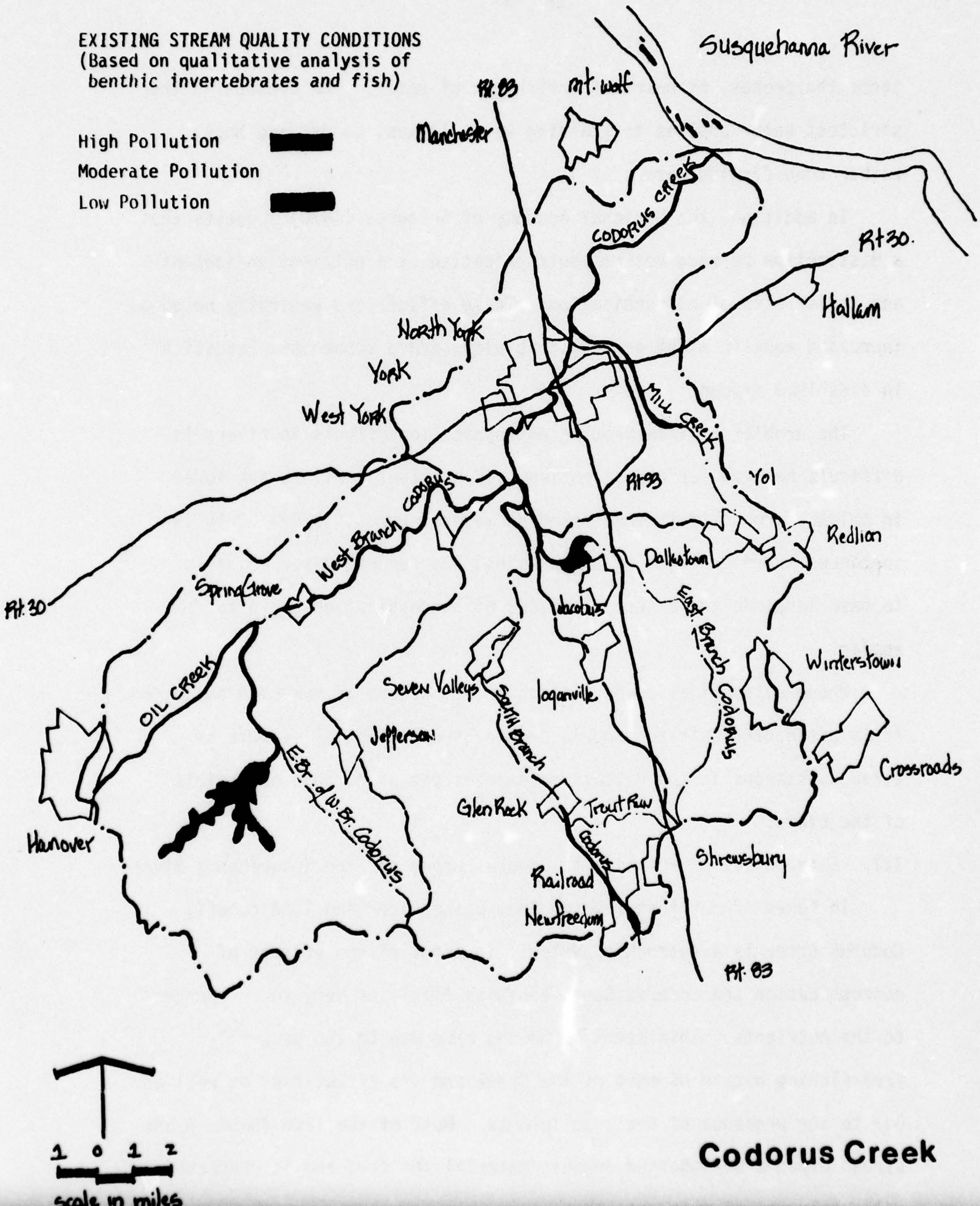
It is safe to say that while the aquatic habitat is severely degraded and is characterized by an absence of a well-diversified fish community, that eutrophication is not likely the cause of this. Re-

ductions in dissolved oxygen contents based on available data seem insufficient to produce the typical annoxia of eutrophic waters and are more likely caused by COD and BOD loadings from waste-water and land runoff than any apparent aquatic vegetation detritus loads. (The accompanying map describes the distribution of pollution effects throughout the basin where data on this subject was available.) Reaches of stream overlined in red exhibit severe pollution degradation, with a clear dominance of pollution tolerant species, and almost a total absence of fish species normally associated with a warm-water stream.

There is no data available that would allow a quantitative assessment of fish production of any kind, Thus, there is no measure of the value of the existing or future sport fishery potential. Throughout most of the headwater streams, including Oil Creek, the West Branch, the Upper South Branch and East Branch of Codorus Creek, stream channels are narrow and the observed water volumes appear insufficient to support a fishery of major recreational importance. Exceptions to this would be the impoundments located on those headwaters where sufficient water in both depth and surface area was retained and fish populations could build up. It seems evident that if a recreational fishery were to be developed following the removal of pollution loads from the basin that the management of impoundments offered the highest potential for this purpose in almost any of the headwater areas of the basin. The lower reaches of Codorus Creek below York Stream has sufficient size and body of flow to support a major warm-water fishery, but at the present time that reach of stream is characterized by 100% pollution-tolerant organisms.

II. The Concept of Eutrophication

In general, the limnological term eutrophication means in simplest



Codorus Creek

terms the process of nutrient enrichment of water. The concept in the strictest sense applies to standing water (lakes, ponds, and bogs) rather than flowing water.

In addition, the National Academy of Sciences (1970) suggests that a distinction be made between eutrophication as a nutrient enrichment and the effects of eutrophication. These effects are generally noted as increased aquatic plant growth, turbidity, and a subsequent reduction in dissolved oxygen.

The problem of interpreting eutrophication effects in rivers is difficult because for any given level of nutrients, rivers are lower in primary productivity than standing waters (Hynes, 1970). Only in instances where geologic aging (erosion) has reduced river channels to base level do the expected effects of eutrophication begin to appear.

Where eutrophication conditions occur because of man-made pollution it is often difficult to experience expected biological effects as toxic substances in the pollutants depress the productive potentials of the biota.

III. Eutrophication Relative to Codorus Creek and the Susquehanna River

In terms of nutrient loading from waste-water and land runoff, Codorus Creek is a eutrophic system. In terms of the effects of eutrophication the Codorus Basin exhibits little or very few responses to the nutrients. This seems to be the case due to the generally free-flowing nature of most of the Creek and its tributaries as well as due to the presence of toxic pollutants. Most of the life found in the stream depends on imported organic material for food and is characteristically tolerant of most pollution.

The plant species found in the stream include those associated with high nutrient (especially phosphorous and nitrogen) conditions: Caldophora, Ulothrix, Navicula, and Potomogeton (Hynes, 1970; Comm. of Penn., 1969).

This observation, however, should be taken with much reservation since all of those species may be found in non-eutrophic water as well. Only the knowledge of the relative abundance of these eutrophication index species would provide the adequate proof of high nutrient loads. Since quantitative data is not available such proof cannot be claimed.

The contribution of the current pollution loading to nutrient levels in the Codorus Creek Basin is documented through direct chemical analysis. (Comm. of Penn., 1967-69)

These findings are the basis for a series of water quality improvement standards for the Basin. (Anonymous, undated)

The concept of eutrophication becomes much more germaine to the problems of the lower Susquehanna River than for Codorus Creek itself.

Both above and below the outfall of Codorus Creek into the Susquehanna the water of that River has been impounded by a series of three power dams. Since impoundment structures duplicate the base level effects of geological aging, the Susquehanna can be likened to a series of lakes. Here the effects of nutrient loads can express themselves in normal ways: 1) the entrapment of nutrients in lake bottom sediments; 2) the establishment of rooted aquatic plants; 3) massive blooms of phytoplankton; 4) stratification (thermal) of the impounded water with a possible depletion of dissolved oxygen at lower levels.

Barring the elimination of the impounding structures, the reduction of eutrophication and its effects will likely be achieved only with a

lessening of the nutrients reaching the main stem of the Susquehanna through its tributaries.

Codorus Creek under its current pollution load is an important contributor to the lower Susquehanna eutrophication problem. Of special interest is the proportional contribution of phosphorous compounds. While aquatic plant growth is dependent on all basic nutrients (nitrogen, potassium, phosphorous, calcium, iron, sodium and sulphur) it is now suspected (N.A.S., 1970) that phosphorous in its several biologically useful forms is an (if not the) important limiting factor in plant growth. Potassium is a common nutrient in water and is rarely found in concentrations low enough to inhibit plant growth. Nitrogen may be fixed in a variety of ways from plant metabolisms to combustion oxidation of fuels. It is recognized that blue-green algae (a prominent eutrophication index plant) may metabolize nitrogen directly from the atomosphere.

Phosphorous, however, seems to act as a stimulus to plant growth in concentrations as low as 1 mg/L. Many plants are highly efficient at metabolizing phosphorous and the rate of take-up by them of soluble phosphorous approaches being instantaneous.

Reduction of the nutrient level in Codorus Creek with an emphasis on phosphorous would be effective in reducing eutrophication in the Susquehanna. It should be pointed out, however, that the overall Susquehanna pollution problem is caused only in a small way by the Codorus Creek loadings. The Codorus Creek Basin is only slightly more than 300 square miles of a total of more than 27,000 square miles of the Susquehanna Basin. Pollution and sediment loads in the lower

Susquehanna are the result of accumulations derived from more than 80% of the River's drainage area.

IV. Relationship of Susquehanna Eutrophication to Chesapeake Bay

Nutrient enrichment of upper Chesapeake Bay is strongly related to discharges from the Susquehanna. Approximately 85% of the water in the Bay above the Potomac River outfall is contributed by the Susquehanna.

It is suggested by Carpenter, et al. (1970) that nitrogen, mostly in the form of nitrate, is the abundant nutrient. Phosphorous appears in relatively low concentrations - 1.5mg/liter - in the winter and spring and 1mg.L in summer and fall. Indications are that there is sufficient plant life in the Chesapeake Bay to utilize all the nitrogen at least once in plant production and to cycle phosphorous twice through the plant community.

It is significant that the lower phosphorous content of Susquehanna River water entering the Bay is attributable to the eutrophication effects in the lower Susquehanna impoundments. There biological activity captures much of the phosphorous preventing its release to the estuary and the Bay.

Despite reductions in phosphorous entering the Bay, eutrophic effects are present in the form of algal growth. Estimates by Carpenter et. al. (1970) indicate a fixing of 0.2mg/liter/day of organic carbon through algal photohynthesis in the upper Bay.

A reduction of nutrient enrichment of Chesapeake Bay by improving the water quality of the Susquehanna is simply obvious. The rate at

which recovery might occur following such reduction is difficult to guage. Nitrogen and phosphorous concentrations in the sediments of both the River and the Bay have not been adequately studied to make a recovery time prediction. Nor have the natural mechanisms for recycling the sediment nutrients been studied sufficiently to make such predictions.

V. Analysis of Waste-Water Treatment Performance Classes

Class A. Removal of nutrients appears adequate to reduce the present rate of algal and plant growth in the basin under existing plant growth conditions. These conditions, however, include an increasing load of suspended solids, as one moves from the headwaters to the mouth of the stream. The resulting turbidity would have a depressing effect on plant growth because of the interference with sunlight penetration into the water. The relatively lower level of suspended solids removal under Class A treatment would likely retain some of the same conditions in the lower reaches of the stream.

Classes B and C. These performance levels would adequately answer any problems of suspended solids and reduce significantly the BOD loadings of the stream.

Classes D, E, and F. All three of these performance classes could be expected to remove sufficient pollutants and nutrients to restore high water quality throughout the basin. While the early effects of this degree of nutrient removal would be desirable, it is possible that over the long run, such a high degree of phosphorous and nitrogen removal might depress the fertility level of water and lower the potential for aquatic production in Codorus Creek (Hynes, 1970).

There is a problem in evaluating the expected outcome from waste-

water treatment in any of the performance classes because of the paucity of data available on existing aquatic conditions. The most recent comprehensive study of physical, chemical and biological factors of the stream was conducted in June of 1969. This study made only one sample at each of 16 stations through the watershed and is unreliable as a source of physical and chemical baseline data on existing stream conditions. However, the sampling of vertebrate and invertebrate organisms and aquatic plants in the stream at that time revealed that at 12 of the 16 stations, 80% or more of the organisms were considered pollution tolerant. Thus, there is no reason to assume that an important contribution to the restoration of high water quality leading to a normal biological warm-water community would not be forthcoming from any of the 6 treatment classes.

VI. Ecological Impact Analysis of Proposed Alternative Waste-water Management Systems.

Major ecological impacts expected from the implementation of any of the proposed systems is interpreted based on changes in flow volumes in Codorus Creek and its tributaries. Accepting that any one of the six performance levels may be opted for, the alternative systems seem to differ largely in the degree to which they regionalize the interception of waste-water and the degree to which they concentrate the treated effluent discharge.

Our analysis will be based on the following ecological principals with respect to the relationship of flow regimen to the performance of the biological community of the river.

1. Flowing water supports primary productivity in inverse proportion to the force exerted by its flow.

2. The potential amount of aquatic organisms at any trophic level supported by a stream is proportional to the cross-sectional area of water in the stream channel.
3. The dissipation of thermal loading in a stream is accelerated in proportion to the energy expressed in current or flow forces.
4. The lower the water temperature, the higher is the potential for dissolving oxygen.
5. The higher the velocity of flow the greater the size of suspended particles transported by the moving water.

Alternatives IA, IB

Both of these alternative systems result in an export of water from the upper and middle basin to either the Susquehanna or to the main stem below the city of York.

These systems would reduce the volume and consequently the rate of flow in all parts of the basin. The effects would be to reduce the extent (cross-sectional area) of the aquatic habitat, thus lowering the potential of the river and its tributaries to support numbers of aquatic organisms. Reduction of flow would also lower the "scrubbing" capacity of the stream to carry off sediments that depress the primary producers and clog the habitats of benthic organisms.

There would be some compensation for the above productivity losses since lowered flow forces would encourage increases in green plant productivity.

It is possible to anticipate that if one of the lower level performance classes of treatment was implemented there might be an

increase of eutrophication effects in the stream as a result of increases in plant productivity. Reductions in flow would cause the retention of heat and reduce the dissolved oxygen potential.

Alternative II

This system would have the least possible negative effect on flow characteristics in the Basin.

Alternatives III, IV, and V

These systems would result in an export of water from Mill Creek with effect as described for Alternatives IA and IB.

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CHAPTER V

TERRESTRIAL ECOLOGY IMPACT STUDY

This investigation was conducted in November and December 1971. The purpose of the study was:

1. To describe the existing ecology of the Codorus Creek Watershed, especially on the land disposal areas.

2. To identify, if any, the probable ecological changes of importance that might result from the operation of the proposed land disposal areas.

Study methods included a review of literature pertaining to the ecology of the watershed and a visit to the watershed. The land disposal areas under question were observed from the air to obtain a general baseline of the distribution of the various biotic communities. This was followed by on the ground visits to the land disposal areas for the purpose of identifying dominant species of plants within the various communities and to refine the description of species and habitat diversity.

I. General Ecology of Codorus Creek Watershed

The optimal climax or mature vegetation of Codorus Creek Watershed is Oak-Hickory (Quercus - Carya). Dominant species include Red Oak (Q. rubra), Black Oak (Q. velutina), White Oak

(*Q. alba*), Chestnut Oak (*Q. prinoides*), Pignut Hickory (*C. cordiformis*), Mockernut Hickory (*C. tomentosa*), and Butternut (*Juglans cinerea*). Generally, the Oak-Hickory vegetation type is found on drier, well-drained soils in regions receiving less than 45 inches of precipitation annually (Shelford, 1963).

Vegetation currently occupying the watershed falls into three categories: relatively mature Oak-Hickory forest; agricultural land (crops, meadow and pasture); and river bottom land communities.

There is notably little evidence of early stages of vegetative succession such as one would expect in fencerows and abandoned fields. In the main, such early and intermediate aged vegetation is found along stream flats and drainage ways. In short, the existing terrestrial ecology of Codorus Watershed can be characterized as small to medium (1 to 20 acres) Oak-Hickory woodlots scattered among farm land.

The animal life in the watershed is typical of the Northeastern United States. Wildlife species of recreational importance are Cottontail Rabbit (*Sylvilagus transitionalis*), Ring-necked Pheasant (*Phasianus colchicus*), Bob-White Quail (*Colinus virginianus*), Gray Squirrel (*Sciurus carolinensis*), Fox Squirrel (*S. niger*), and White-tailed Deer (*Odocoileus virginianus*). (Druitt, 1967). All these species are common to habitats created by agriculture.

II. Ecology of the Land Disposal Areas

A. Hanover and Penn Townships Service Area

This area, more than the other two land disposal sites, has less forest land in proportion to agriculture and large lot suburban uses. Aerial observation provided an approximate percentage of 20% to 30% forest, largely in the form of small woodlots. Agricultural practices in this area are characterized by "clean" farming -- few fencerows, brushlots and transition zones between cultivated fields and forest.

B. P.H. Glatfelter Service Area

This area also has a low proportion of woodlot to farm fields. The largest segment of forest appears on the upper slopes of the lines of hills roughly marking the east and west margins of the disposal area. Most early successional vegetation is located along the small drainage channels. There are few fencerows and brushlots.

C. Glen Rock, Shrewsbury, Railroad, and New Freedom Service Area

This area contains the highest proportion of woodlot to farm land (30% - 40%). Similar to the other service areas, this one is characterized by "clean" farming.

III. Interpretation

Our analysis of probable ecological change in the terrestrial environment anticipated from land disposal operations is based on the following principles:

A. Diversity of species in an ecosystem is an index of stability -- that is, the long run capacity of the system to endure under expected kinds and intensities of physical or

chemical stress. The greater the numbers of species and the more equitable their proportional presence in the biotic community, the greater is stress resistance.

B. Variety of plant-formed habitats in an ecosystem is an index of the diversity of annual species that may be expected to live in any given area or region (Mac Arthur, 1967).

C. Succession is a natural process whereby simpler biotic communities (those that are low in diversity and habitat variety) are supplanted by a series of ever more complex communities, each successively having more species diversity and habitat variety. This process leads toward a theoretical mature or "climax" community which has the greatest diversity and habitat variety, and the greatest long run stability. Stated another way, earlier stages of succession are simple and growth-oriented, and later stages are complex and stability-oriented.

Overall, the land disposal service areas exemplify, in the main, the two extremes of the successional process. The woodlots are near maturity and the agricultural areas are like early or youthful growth systems. Normally one would expect a variety of intermediate stages of biotic community succession between both early and late stages, but the clean farming practices have largely eliminated them. It is in the intermediate communities that the animals most valued as game species live.

IV. Conclusions

A. The proposed operations of the land disposal areas

would have no appreciable effect on the mature forest land. Liquid effluent and sludge application would affect only the simpler agricultural communities which, being oriented and managed toward growth, would benefit from both nutrient and water availability.

B. Storage lagoons as planned would result in an absolute loss of already scarce intermediate biotic communities, and an extirpation of their wildlife. This is especially important within the proposed land disposal areas because so little of these wildlife-supporting communities are present there.

Some compensation for losses of wildlife habitat could be realized if intermediate successional communities were managed for along the rights of way for waste-water intercept and effluent distribution lines. (Note: The exact location of intercept and distribution lines had not been described at the time of our analysis. Therefore, no ecological impact estimates can be made regarding them.)

The biotic productivity of the soils in the Codorus Watershed is relatively high and this basic factor should reflect a high capacity to support wildlife populations. However, advantage should be taken of opportunities to enlarge habitats such as brushlots, small cattail marshes, and unmowed or ungrazed fields.

C. A review of literature and our own observations indicate that no areas of special or unique ecological importance

will be disturbed by the proposed land disposal operations. (It is impossible to comment on the possible disturbance of such areas by the waste-water intercept or effluent distribution lines at this time.)

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CHAPTER VI

PUBLIC HEALTH RISK IMPACT STUDY

General Aspects

Recreational Use of Water and Disease - Most States have developed criteria for the sanitary quality of natural waters used for bathing. However, there has been considerable disagreement among various regulatory agencies on the precise microbiological standards that define permissible densities of total-coliform or fecal-coliform indicator organisms permissible if water is to be used for bathing. Most States require a sanitary survey in addition to other criteria, such as coliform counts. Some States have no coliform standards; such an absence of an upper coliform limit is consistent with a British epidemiologic investigation that concluded that there is a negligible health hazard associated with bathing in sewage-polluted marine waters in the absence of gross, visible fecal contamination.

Studies by Stevenson on Lake Michigan and the Ohio River showed that an epidemiologically detectable health effect in swimmers may begin at a level of total coliform contamination of approximately 2400/100 ml. Using an extrapolation of an average level of fecal coliforms of about 20% of the total coliform count, and reducing the 2400/100 ml value by half to produce a (unknown) "safety factor", an upper limit of a log mean of 200 fecal coliform/100 ml was developed for swimming (and an average level of 2000 fecal coliforms/100 ml for general recreational use) by the Federal Water Pollution Control Administration (FWPCA) in 1968. However, Henderson and others have criticized these standards as too restrictive for a number of reasons. It is clear from an evaluation of available scientific literature on the relationships between swimming and disease that more data are needed to more precisely define the threshold level of microbial contamination that might result in disease in the general population associated with various forms of recreational water contact. Nonetheless, the standards cited above (FWPCA) seem reasonable at present as minimum permissible levels; no evidence is currently available to indicate that these standards should be lowered.

Stevenson showed that swimmers have more illnesses than a comparable control group of non-swimmers. Eye, ear, nose, and throat disease represented more than half of the overall incidence in his studies, gastrointestinal disturbances about 20%, and skin and other illnesses the remainder. Since any large, natural body of water may be contaminated with almost any type of fecal microorganism from people, at least in theory any fecal-oral transmitted infection might result from oral contact with such contaminated water. In addition, diseases that have been associated with skin (or other) contact with water contaminated with microorganisms in the continental U.S. include: schistosome dermatitis, leptospirosis, tularemia, some tuberculous skin infections, and amoebic meningoencephalitis; the numbers of known cases of these diseases due to water contact is small.

Viral Hepatitis - Viral hepatitis may be transmitted by contaminated water, contaminated shellfish or other food or drink, person-to-person contact, the parenteral route, and through the air. However, viral hepatitis probably is most frequently transmitted as any other fecal-oral disease, by close personal contact. Special mention is made of hepatitis for two reasons: first, techniques have not yet been developed to culture and study this virus in the laboratory,

and, second, epidemiologic data available indicate that hepatitis viruses are unusually resistant to water-treatment processes. There have been a number of outbreaks of viral hepatitis associated with fecally contaminated drinking water, some with chlorinated drinking water. The hazard of viral hepatitis associated with ingesting untreated, fecally contaminated water during recreational activities such as swimming could be significant.

Fish and Shellfish - Shellfish harvested from polluted areas are capable of causing human disease, including typhoid fever, various enteric infections, and viral hepatitis. If standards that have been developed for use in shellfish sanitation are followed, including strict enforcement of prohibition of harvesting of shellfish from areas known to be polluted, the hazards of infection from shellfish are minimal. Diphyllobothriasis can be acquired by eating inadequately cooked, infected fish. Uncontaminated fish or shellfish can become contaminated with various microorganisms after harvesting, and this contamination can cause disease. And, there have been a number of reports of paralytic shellfish poisoning.

Irrigation with Sewage and Disease - Irrigation with treated sewage has been demonstrated to be a satisfactory method for reuse of effluents as well as a method to improve yields of plants. However, several possible health hazards may occur in the use of this practice. First, various human parasites or other pathogens may survive in sewage, including treated sewage, and contact with such sewage could cause disease if the pathogens were subsequently ingested. There have been several reports of illness in children who have played in sewage-contaminated water. The hazards to health of ingesting fruit or vegetables commonly eaten raw that have either been grown with sewage-contaminated water or rinsed in such water are well known. Odors could result from sewage irrigation. Also, it is potentially possible for land irrigated by sewage to produce significent quantities of insects that might either be nuisances or might be capable of spreading disease. It is not known whether aerosols of sewage produced during irrigation would be hazardous to health; there probably is but a minor hazard to such aerosols, since there are no reports in technical literature proving that excess disease has occurred in individuals who continuously work at sewage treatment plants, where airborne microbial contamination from sewage does occur.

Beefoor pork tapeworm infections in cattle or swine (which can be transmitted to man by uncooked, infected meat) can be acquired as a result of pasture irrigation with sewage effluents or by animals drinking contaminated irrigation water containing the parasites.

Microbial or other contamination of ground water could occur as the result of irrigation with sewage. Factors that influence such ground-water contamination might include the degree of contamination in the sewage used for irrigation, the type of soil, the depth of the ground-water table, and the presence of channelized or fractured rock that would permit rapid infiltration of sewage without biological or physical "filtration".

There should be no hazards to health, other than those discussed just above, of spreading sewage sludge on agricultural land. Sludge is commonly spread to dry (on sand beds) at or near sewage treatment plants.

Summary of Diseases that May Be Transmitted by Contaminated Water - A large number of diseases may result from various types of contact with water contaminated with microorganisms or other parasites, as is noted above and in a number of references in the bibliography below. In summary, these diseases in the U.S. include: infectious hepatitis; giardiasis, typhoid and paratyphoid fevers; salmonellosis; shigellosis; leptospirosis; amebiasis; "gastroenteritis" of unknown etiology due to microbial contamination, including viral contamination; echinococcosis; balantidiasis; schistosome dermatitis; tuberculous skin infections; and amoebic meningoencephalitis.

The dose of microbial (or parasitic) contamination, the virulence of pathogenicity of the organisms, the immune status (and other host characteristics) of those exposed, and other factors may influence the amount of infection and disease that results from human exposure to the contaminating organisms.

Hygenic Aspects of Various Alternatives for Waste Water Management, Codorus Basin

It is entirely possible that whatever waste-water related hazards to health that exist, now or in the future, in the Codorus Creek Basin may be influenced most greatly by (a) approximately 25,000 people using unchlorinated water (including 19,000 using individual water-supply systems) and (b) an estimated 40% of the population using septic tanks. Providing chlorinated, municipally supplied water and municipal piped sewerage for as many people in the Basin as possible would probably result in greater health benefits than any of the waste-water management systems that have been proposed.

Any of the alternatives of waste-water management submitted for evaluation that provide improved sewage treatment using effluent discharge to receiving bodies of water should reduce present hazards to human health associated with the existing system of waste-water management. The magnitude of the present health hazards associated with contact with water bodies receiving sewage is unknown and probably is small, because of restrictions in such contact in the Codorus Basin.

The "base-line" proposed system for this evaluation, Alternate II, Option 1, presumably will reduce microbial contamination significantly in the various watercourses in the Codorus Basin by providing improved sewage treatment in the Basin. Since Alternate II, Option 3 provides still further treatment than Option 1, presumably still further reduction in microbial contamination of watercourses would result, depending on the degree of final chlorination used (and probably other aspects of treatment). These reductions of microbial contamination may reduce health hazards if water contact is the same as present; or these reductions might provide the basis for wider recreational use of watercourses in the Basin.

Obviously, Alternate 1b, Options 1 and 7, will still further reduce microbial contamination over the two Options of Alternative II mentioned above. Again, these reductions may reduce health hazards if water contact is the same or permit wider recreational use of watercourses.

Alternatives 4 and 5a will produce unknown effects on microbial contamination of watercourses, on ground-water quality, and on health. Well designed and operated systems for land irrigation should result in but small increases in microbial contamination from the water that eventually reaches watercourses. However, microbial (or other) contamination of ground water might increase; such an increase might, in turn, have deleterious health effects to those people in or near the irrigated area who have individual water-supply systems. Actual studies of the effects of irrigation with sewage effluents on ground water might be indicated in areas proposed for such irrigation before adoption of Alternatives 4 or 5a.

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